

# Oil and Gas Leasing Program

June 1985

STATE OF WASHINGTON  
DEPARTMENT OF  
**NATURAL RESOURCES**  
BRIAN BOYLE  
COMMISSIONER OF PUBLIC LANDS  
ART STEARNS — SUPERVISOR

The Board of Natural Resources, on June 13, 1985 in Resolution 490, adopted the Oil and Gas Leasing Program to carry out the goals and policies for oil and gas leasing on Department-managed lands.

## PROLOGUE

A great share of a nation's wealth comes from its natural resources - mining, agriculture, forestry and fishing - through application of labor and technology. An increase in significant new wealth to a nation or state is usually as a result of sound development of its natural resources. These facts are basic to every resource management agency.

Continuing world demand for petroleum products is the underlying reason why such natural resources are a potential source of wealth to the state.

Modern exploration for oil and gas presents a far greater challenge than ever before. Sites that have potential that would have been ignored or overlooked ten years ago, today can be identified and drilled using modern exploration techniques. New techniques in exploration and production are being devised to bring these resources into production.

The geology of the Pacific Northwest has long been considered favorable for the discovery of oil and gas. For example 20 billion cubic feet of natural gas worth \$60 million have been discovered in Oregon since 1979. Washington is still considered a "frontier" area with geological conditions in a number of areas suggesting the presence of oil and gas.

It is the purpose of this document to provide a basis for exploration and production which will fulfill trust principles in ways which protect other natural resources and maintain high environmental standards.

## TABLE OF CONTENTS

Prologue . . . . .	ii
Table of Contents . . . . .	iii
List of Figures and Tables . . . . .	vi
PREFACE . . . . .	vii
Environmental Analysis and Public Review . . . . .	viii
Organization of the Document . . . . .	viii
 BACKGROUND . . . . .	 1
Legal Context of the Oil and Gas Leasing Program . . . . .	3
Enabling Act . . . . .	3
Federal Land Grant Trusts . . . . .	3
Forest Board Trusts . . . . .	6
Aquatic Lands . . . . .	6
State and Federal Laws . . . . .	7
Overall Management Direction . . . . .	9
The Department of Natural Resources . . . . .	11
Board of Natural Resources/Department Relationship . . . . .	15
Oil and Gas Conservation Committee/Department Relationship . . . . .	16
 INTRODUCTION TO OIL AND GAS EXPLORATION AND DEVELOPMENT IN WASHINGTON . . .	 17
History of Oil and Gas Exploration . . . . .	19
Areas of Drilling Activity . . . . .	19
Potential Areas of Oil and Gas Interest in the State of Washington . . . .	21
Areas of Interest . . . . .	21
Summary . . . . .	22

Phases of Activity . . . . .	24
Exploration . . . . .	24
Development and Production . . . . .	31
Reclamation . . . . .	35
Lease Abandonment . . . . .	35
 DEPARTMENT OF NATURAL RESOURCES OIL AND GAS LEASING PROGRAM . . . . .	37
Introduction. . . . .	39
Revenues. . . . .	41
Relationship of Oil and Gas Revenues to Other Trust Land Revenue Source .	41
Policies . . . . .	42
Lands Available for Lease . . . . .	42
Lands Available for Conditional Lease . . . . .	42
Lands Withheld From Leasing . . . . .	42
Leasing of Aquatic Lands. . . . .	43
Water and Wetland Areas . . . . .	43
Department-Initiated Oil and Gas Lease Applications . . . . .	43
Notification of Oil and Gas Leasing . . . . .	43
Plan of Operations . . . . .	43
Right of Entry . . . . .	43
Seismic Exploration Permits . . . . .	44
Resource Protection . . . . .	44
Road Construction . . . . .	44
Preliminary Investigations . . . . .	44
Seismic Exploration . . . . .	44
Stratigraphic and Exploratory Drilling . . . . .	44

Resource Protection . . . . .	45
Sensitive Area Planning . . . . .	45
Heritage Protection . . . . .	48
Natural Area Preserves and the Registry Program . . . . .	49
Cultural Resources . . . . .	49
Preliminary Investigations . . . . .	50
Plan of Operations and Right of Entry . . . . .	50
Investigative Activities. . . . .	50
Oil and Gas Leasing Procedure . . . . .	52
Preauction Activities . . . . .	52
Auction Procedures. . . . .	52
Leases. . . . .	54
Drilling . . . . .	55
Development and Production . . . . .	56
Reclamation . . . . .	56
GLOSSARY . . . . .	57
REFERENCES . . . . .	61
APPENDICES . . . . .	67
Appendix A - Drilling Mud Materials . . . . .	A-1
Appendix B - Oil and Gas Inspection Report . . . . .	B-1

## LIST OF FIGURES AND TABLES

Figure	Page No.
1 Department Natural Resources Area Management Boundaries . . . . .	14
2 Seismographic Testing . . . . .	26
3 Location Layout for a Well 6,000 to 9,000 Feet Deep . . . . .	28
4 Location layout for a Well 9,000 to 15,000 Feet Deep. . . . .	29
5 Oil/Gas Well Casing . . . . .	30
6 Flowing Oil Production . . . . .	33
7 Examples of Directional Drilling . . . . .	36
8 Example of Possible Horizontal Displacement . . . . .	36

### Table

1 Department of Natural Resources Table of Organization . . . . .	13
2 Estimated Acreage Requirements Within a Lease Section for Oil and Gas Development . . . . .	27
3 Basic Selected Sensitive Area Criteria Factors Listed by Environmental Element . . . . .	46
4 Flow Chart of Lease and Permit Processing Relationship . . . . .	53

## PREFACE

The Department of Natural Resources, State of Washington, is authorized to lease state-owned land for oil and gas exploration, development and production. (Chapter 79.14 RCW). In recognition of potential environmental impacts and the disruption to established land uses which may occur from oil and gas exploration, development and production activities the department establishes the following process.

### I. Program Plan

The plan describes the department's Oil and Gas Leasing Program. The department accepts or rejects lease applications, auctions leases, monitors the lessee's activities and provides information to the public on leasing activity. Preliminary investigations, exploratory drilling, development, production and reclamation are done by the lessee. Although these operations are not conducted by the department, the department can condition or deny any or all of the actions through policies, laws and lease terms.

### II. Final Programmatic Environmental Impact Statement (FEIS)

An environmental impact statement has been written to form a base line for evaluating proposed oil and gas activities. Since the program will be applied to a wide range of topographic, climatic, soil, aquatic and vegetative conditions, a general description of probable impacts is provided.

### III. Supplemental Environmental Protection Procedures

A State Environmental Policy Act (SEPA) checklist will be completed and threshold determination made by the department prior to leasing. The lessee or operator will complete an additional checklist and the designated lead agency shall make the determination before beginning exploratory drilling, development or production activities.

## ENVIRONMENTAL ANALYSIS AND PUBLIC REVIEW

The purpose of this document is to present and explain the department's Oil and Gas Leasing Program. This program document is accompanied by a separate Final Programmatic Environmental Impact Statement (FEIS). In general, the FEIS presents the program elements and their alternatives, analyzes the potential environmental impacts of each and discusses the rationale for the selection of the preferred alternative. The purpose of the FEIS is to provide general information to assist department decision makers in selecting the preferred program elements and to disclose the environmental impacts of the program to other agencies and the public.

The program and FEIS are limited to decisions on exploration and leasing of department-managed land for oil and gas purposes. Possible future management decisions on use of specific state land parcels are not intended to be part of the program or FEIS. These decisions could include, for example, management for residential uses, commercial leasing, mineral leasing and fossil fuel development and production. When and if such

future decisions are made, they will be subject to independent environmental analysis.

The program and accompanying FEIS are also not intended to cover activities on private or federal lands, or lands owned and managed by other state agencies for specific purposes such as state parks and wildlife areas. Nor are they intended to cover the department's administration of the Oil and Gas Conservation Act on private or state lands. The state administers those regulations through the department's Division of Geology and Earth Resources. The department's land management activities on state lands are subject to those regulations. This program does not alter those regulations in any way but does show the relationship of the Oil and Gas Leasing Program to them.

The program document and the accompanying FEIS were preceded by public meetings conducted in August 1983 in Aberdeen, Ellensburg, Ephrata, Issaquah and Olympia. Meetings were also held with the Departments of Ecology, Fisheries and Game. Approximately 80 people attended the meetings.

Public meetings were also held in Moses Lake, Wenatchee, Yakima, Everett, Issaquah and Olympia in January 1985.

Changes shown in this document address concerns expressed at the public meetings and in written comments received on the draft program and draft PEIS.

The program document and the FEIS are being made available to federal, state and local agencies, tribes, organizations and individuals.

## ORGANIZATION OF THE DOCUMENT

The program document is organized in the following sections: Background; Introduction to Oil and Gas Exploration and Production in Washington; and the Oil and Gas Leasing Program. It also includes a glossary and bibliography.

The Background section describes department organization, the Board of Natural Resources' role and the relationship of the Oil and Gas Conservation Committee to the department and the Board.

The second section provides a history of oil and gas exploration activities in Washington. It also describes the potential for oil and gas discovery and a basic description of the phases of oil and gas production.

The final section describes the department's Oil and Gas Leasing Program including provisions for resource protection and procedures to prevent irreparable disruption of the natural environment.



## **BACKGROUND**

## LEGAL CONTEXT OF THE OIL AND GAS LEASING PROGRAM

Lands managed by the Department of Natural Resources were acquired (1) from the federal government through the Congressional Enabling Act of 1889, (2) from the counties, and (3) by gift, purchase and escheat. These lands involve 2,893,040 acres of uplands and 2,000,000 acres of aquatic lands. In addition the department owns approximately 475,000 acres of mineral rights only -- mineral rights which were retained by the state when the land was sold or mineral rights which were acquired through exchange.

Uplands are managed to generate income for support of the various trusts while preserving trust assets for future beneficiaries. Aquatic lands, however, are managed to provide a balance of public benefits for all citizens of the state.

### ENABLING ACT

The Congressional Enabling Act of 1889, which admitted Washington to the Union, put limits on the sale, lease and management of state-owned lands. However, these lands may be leased for oil and gas purposes pursuant to statutes set forth by the legislature.

### FEDERAL LAND GRANT TRUSTS

Federal land grant trusts are endowments of land by the United States to the state of Washington to be sold, leased or managed to support designated beneficiaries in perpetuity. The federal grant lands were donated to Washington in 1889 in the Congressional Enabling Act providing for admission of the territory of Washington as the 42nd state. These donated lands were expressly reserved in the Act for (a) support of the common schools (§ 10);

(b) erecting public buildings for legislative, executive and judicial use (§ 12-15); (c) the use and support of an agricultural college (Washington State University) (§ 16); (d) a state university (University of Washington) (§ 14); (e) establishing and maintaining a scientific school (Washington State University) (§ 17); (f) state normal schools (now regional universities) (§ 17); and (g) state charitable, educational, penal and reformatory institutions (§ 17). The Washington Legislature has designated the Department of Natural Resources as manager and trustee of the lands to benefit the institutions supported.

### Case Law Pertaining to Federal Land Grant Trusts

Seven federal and state cases show how the courts have applied many of the foregoing principles to the sale, lease and management of federal grant trust lands.

In Ervin v. United States 251 U.S. 41 (1919), the U.S. Attorney General sued for an injunction to prevent the New Mexico Land Commissioner, the trustee of New Mexico grant lands, from spending trust earnings for unauthorized purpose to publicize the resources and advantages of New Mexico. The New Mexico Land Commissioner argued that this advertising was a proper administrative expense as it could increase the value of the trust lands.

The U.S. Supreme Court, however, granted an injunction prohibiting these expenditures. It ruled that the trusts were individually created to support public institutions specified in the Enabling Act. Therefore, the trustee could not use proceeds from a specific

trust to benefit the state generally, even if the trust also might be indirectly benefited; rather, Congress intended that the trustee apply the trust earnings to the fund created to "support" the public institution designated in the Enabling Act.

In Lassen v. Arizona, 385 U.S. 458 (1966), the Arizona Highway Department sued the Land Commissioner, the trustee of grant lands, to condemn a highway right of way. The department argued that it need not compensate the trust, since a highway across trust lands would enhance the value of remaining trust lands in an amount at least equal to the value of the trust lands taken. The U.S. Supreme Court rejected the argument and agreed with the Commissioner that the department must pay the trust for the property taken. The Supreme Court stated:

The Enabling Act unequivocally demands both that the trust receive the full value of any lands transferred from it and that any funds received be employed only for the purposes for which the land was given. First, it requires that before trust lands or their products are offered for sale they must be "appraised at their true value" and that "no sale or other disposal . . . shall be made for a consideration less than the value so ascertained . . ." Second, it imposes a series of careful restrictions upon the use of trust funds. As this Court has noted, the Act contains a "specific enumeration of the purposes for which the lands were granted and the enumeration is necessarily exclusive of any other purpose." [Ervien v. United States, *supra*.] The Act thus specifically forbids the use of "money or thing of value directly or indirectly derived" from trust lands for any

purposes other than those for which that parcel of land was granted. It requires the creation of separate trust accounts for each of the designated beneficiaries, prohibits the transfer of funds among the accounts, and directs with great precision their administration. "Words more clearly designed . . . to create definite and specific trusts and to make them in all respects separate and independent of each other could hardly have been chosen." [United States v. Ervien,] 246 F. 277, 279.] All these restrictions in combination indicate Congress' concern both that the grants provide the most substantial support possible to the beneficiaries and that only those beneficiaries profit from the trust.

U.S. v. 111.2 Acres of Land in Ferry County, Washington, 293 F. Supp. 1042, affirmed 435 F. 2d 561 (1970), is a Washington case adopting the principles set forth in Ervien and Lassen. The United States Government sought to acquire state school trust lands for a federal irrigation project. The U.S. argued that, as trust grantor, it was permitted to take the land without paying for it. The court disagreed, stating:

The school lands provisions of the Enabling Act further a liberal policy of school support . . . In this context the principle of indemnity requires that no land or proceeds be diverted from the school trust unless the trust receives full compensation. This principle is explicitly a part of the Washington Enabling Act.

The court concluded that donating school trust lands to the United States would constitute a breach of trust by

the trustee (State of Washington). The court ordered the United States to pay the trust the full market value of the land.

In State v. University of Alaska, 624 P. 2d 807 (February 27, 1981), the State of Alaska sought to include university grant land within Chugach State Park. The university opposed this action and sought a declaratory judgment as to whether the land could be used other than to support the university. The Supreme Court ruled with the university, stating:

Because the land was to be held in trust for the university, we must determine whether inclusion of the land in Chugach State Park caused a breach of the trust. The trial court concluded that the inclusion of university land in the park violated the trust provision of the federal grant. We agree. The use that can be made of park lands as compared to state lands in general is severely restricted. Trees may not be cut, minerals may not be removed, nor can the land be used for raising farm animals. The general principle is that park lands are to be managed in a way that will increase the "value of a recreational experience." It is apparent that this objective is incompatible with the objective of using university land for the "exclusive use and benefit" of the university. The implied intent of the grant was to maximize the economic return from the land for the benefit of the university. This intent cannot be accomplished if the use of the land is restricted to any significant degree.

Oklahoma Education Association Inc. v. Nigh, 642 P. 2d 230 (Okla. 1982), and in Anderson v. Board of Educational

Lands and Funds, 256 N.W. 2d 318 (Neb. 1977), the court recognized the trustee must take necessary precautions to protect the trust assets.

More recently, The County of Skamania et al. vs. The State of Washington (102 Wn. 2d 127 P. 2d (1984\*)) reaffirmed the responsibility of the trustee as mandated in the Enabling Act. The Forest Products Industry Recovery Act of 1982 (RCW 79.01.1331 - .1339), which permitted purchasers of timber from state trust lands to default on their contracts, or to modify or extend their contracts without penalty, was found to violate Article 16 Section 1 of the Washington State Constitution. The court held that the legislation breached the state's fiduciary duty as a trustee to act with undivided loyalty to the trust beneficiaries and to manage trust assets prudently.

#### Conclusions from the Legal Background

The Enabling Act and Washington Constitution create an express trust. United States is the grantor; Washington State is the trustee; certain schools, and other designated entities are the beneficiaries of the trust. The congressional intent and purpose in creating these trusts has been construed by the United States Supreme Court to be as follows: The trustee is to sell or manage the granted lands to generate income for the support of those public institutions designated in the Enabling Act. Additional management direction comes from the Washington Legislature, which has the authority to pass laws governing trust management. Such laws are presumed to be valid.

In addition to the constitutional and statutory mandates, the department, as trust manager, possesses certain responsibilities under traditional trust doctrines. The extent to which the whole of common law trust duties apply to a trustee of a federal land grant trust is a judicial question which has not been clearly decided by the courts.

Five common law duties are set forth in this discussion. Two that have been judicially recognized are: (1) The duty to administer the trust in the interest of the beneficiaries and not for the benefit of others, and (2) the duty to use reasonable care and skill to preserve the trust property. Although not directly stated, implicit in the various case holdings is (3) a duty to use reasonable care and skill to make trust property productive of income without unduly favoring present beneficiaries over future beneficiaries. The department, as trust manager and as a creature of statute recognizes that it (4) has a duty as a trustee to follow the Constitution, Enabling Act and laws which affect the state land management programs. Those laws include the Multiple Use Act, Oil and Gas Conservation Act, and other environmental statutes. "Other statutes" include those listed under the heading "State and Federal Laws". This list is not meant to be exclusive. (5) The duty to diversify the management of federal land grant trust assets so as to reduce risk of loss has not been specifically addressed by courts. Diversity of management practices to moderate economic risks is seen by the department as its responsibility and is a program goal.

The whole of these principles lead to the following: In managing the federal land grant trusts the department is to be primarily concerned with generating income for trust beneficiaries but must manage by following prudent practices

and by taking precautions to preserve the trust assets for future beneficiaries. The specific steps taken must be in conformance with the Enabling Act, Washington Constitution and legislation which affects management of the trust assets.

#### FOREST BOARD TRUSTS

Forest Board trusts are forest lands acquired by the state by gift, purchase or transfer by the county to perpetuate the forest resource in Washington. The two types of Forest Board lands are Forest Board Transfer and Forest Board Purchased. Both types are to be managed as state forest lands to benefit the county. The legislature has directed that these lands be held in trust and administered and protected as other state forest lands (Chapter 76.12 RCW). Forest Board lands are available for oil and gas lease by the state provided the mineral rights were acquired at the time of gift, purchase or transfer by the county.

#### AQUATIC LANDS

Currently, the state asserts ownership to approximately 11 square miles of harbor area, 140 square miles of shorelands and 205 square miles of tidelands. The state's ownership also includes the beds of all marine waters within 3 miles of shore and all bedlands of the Puget Sound.

The Department of Natural Resources, as the proprietary agent for the state's aquatic lands, is authorized to issue leases, rights of way and easements on aquatic lands. It may also sell valuable materials from these lands. In addition, the Multiple Use Act (RCW 79.68.080) passed in 1971, requires the department to "foster the commercial and recreational use of the

aquatic environment for the production of food, fibre, income, and public enjoyment from state-owned aquatic lands".

A comprehensive law affecting the state's aquatic lands was passed in 1984. It identifies water-dependent uses as priority uses for state aquatic lands. The law directs the department to manage aquatic lands to provide a balance of public benefits, including public access, environmental protection, renewable resource use and revenue generation consistent with the purpose of the law. (Chapter 79.90 RCW.)

#### STATE AND FEDERAL LAWS.

The Federal Clean Air Act, 42 U.S.C. 7401, et seq., establishes provisions relating to air quality standards, emission controls, methods of achieving or preventing deterioration, and protection of visibility. In managing state lands, the department will ensure that necessary permits are obtained by the operator and applicable regulations are followed.

The Federal Endangered Species Act, 16 U.S.C. § 1531, et seq., with some stated exceptions, prohibits specific acts relating to endangered and threatened species designated under the Act. The department abides by this Act in its oil and gas leasing and other land use decisions.

The State Environmental Policy Act (Chapter 43.21C RCW) directs that to the fullest extent possible, policies, regulations and laws of Washington are to be interpreted and administered in accordance with the policies set forth in the Act, and that all branches of government, including state agencies, follow the guidelines and procedures specified in Chapter 43.21C RCW in planning and decision making. The department, as a state agency, must comply with the requirements of SEPA.

The Oil and Gas Conservation Act (Chapter 78.52 RCW) creates a comprehensive state-wide system of laws and regulations governing oil and gas practices on private and public lands. The purpose of the Act is to foster, encourage and promote the development and use of oil and gas resources in the state, to prevent waste, to assure maximum economic recovery of oil and gas and to conduct operations that will maintain a safe and healthful environment for the people of the state. The regulations establish minimum standards for oil and gas drilling and production practices. As a public land manager the department must comply with the Oil and Gas Conservation Act and require its lessees to comply with this Act.

The Water Code - 1917 (Chapter 90.03 RCW) administered by DOE, establishes guidelines for diversion, maintenance of minimum flows and levels, and protection of standing or flowing surface waters of the state. Regulation of Public Ground Waters (Chapter 90.44 RCW), supplements Chapter 90.03 RCW. It extends the applicable statutes for surface waters to the ground waters of the state.

The Water Pollution Control Act (Chapter 90.48 RCW), administered by the Department of Ecology (DOE), has promulgated regulations for the maintenance and protection of state water resources. Minimum standards are provided. Compliance with the minimum standards is mandatory.

The Hazardous Waste Disposal Act (Chapter 70.105 RCW) administered by DOE, promulgates regulations for designation, management and disposal of hazardous materials and waters.

The Shorelines Management Act of 1971 (Chapter 90.58 RCW), administered by DOE, established a state policy to provide for the management of state shorelines by planning and fostering all reasonable and appropriate uses. Local

government administers the permit system provided by the Shorelines Management Act and local master programs approved by DOE. The department will require its oil and gas lessees to obtain appropriate permits required under the Shorelines Management Act.

The Hydraulics Code (RCW 75.20.100) is part of the Fisheries Code. Pursuant to the Hydraulics Code, a person or government agency proposing any act that will use, direct, obstruct or change the natural flow or bed of any river or stream or that will use any of the waters of the state or material from the streambed, may not commence such activity without approval from the

Department of Fisheries or Game as appropriate. When the department leases state lands for activities which fall within the purview of the Hydraulics Code, the lessee or permittee shall obtain a permit.

The Multiple Use Act (Ch. 79.68 RCW) directs the department to use a multiple use concept in the management and administration of department-managed lands when it is in the best interests of the state and the general welfare of the citizens, and is consistent with trust provisions where applicable. Multiple use is defined as providing for several uses simultaneously.

## OVERALL MANAGEMENT DIRECTION

The department believes that coordinated planning between management programs can provide income to the state and the trusts from a variety of activities yet maintain a healthy natural environment for present and future generations.

In 1984, the department adopted a management plan for department-managed

forest lands and issued a proposed policy plan for aquatic lands. Since the Oil and Gas Leasing Program affects both forest and aquatic lands, the goals of their management plans are repeated here. The Oil and Gas Leasing Program goals further define forest and aquatic land management.

### Forest Land Management Goals

Conserve and enhance the natural resources of state forest land.

Provide a sustained yield of timber through intensive forest management.

Integrate the needs of nontimber resources into the management of the timber resource.

Protect from major losses, such as those caused by fires, insects, animals and diseases.

Provide financial support that balances the level and flow of revenue to the trusts.

Provide for both the short-term and long-term needs of the trusts.

Diversify management practices to moderate economic risks.

Anticipate and respond to market opportunities.

Provide social and economic benefits.

Provide for multiple use on forest land.

Contribute to the viability of the forest products industry.

Contribute to state energy production.

### Aquatic Land Management Goals

Conserve and enhance aquatic lands and associated resources.

Meet or exceed environmental quality standards.

Maintain or improve the productivity and usefulness of aquatic lands.

Provide high quality habitat for wildlife on state aquatic lands.

Provide social and economic benefits.

Promote access to and recreational use of state aquatic lands.

Encourage water dependent uses.

Promote the production on a continuing basis of renewable resources.

Allow suitable state aquatic lands to be used for energy and mineral production.

Generate income from use of aquatic lands.



## **Oil and Gas Leasing Program Goals**

### **Conserve and enhance the natural resources of state lands.**

Integrate oil and gas resource management with the management of other state land resources.

Protect from and reduce or eliminate losses caused by erosion, pollution of ground and surface waters and disruption of wildlife habitats.

### **Provide financial support.**

Provide a financial yield from oil and gas activities through lawful land management.

Provide for both the short-term and long-term needs of the trusts and the public.

Anticipate and respond to varying levels of oil and gas industry activities.

Integrate land uses to moderate economic risks.

### **Provide social and economic benefits.**

Provide for multiple use on state lands.

Contribute to the potential of the oil and gas industry.

Contribute to state energy production potential.

## THE DEPARTMENT OF NATURAL RESOURCES

The legislature's first session in 1889 established the State Land Commission to supervise and control public upland and aquatic lands. Another act during that session created the state School Land Commission to supervise sale and leasing of school lands. In 1893, the two commissions were combined into the State Board of Land Commissioners. This board was replaced in 1897 by the Board of State Land Commissioners.

The State Board of Forest Commissioners was formed in 1905 to supervise protection of forest lands in the state. In 1909, the Board of State Land Commissioners membership was reorganized and administrative control over the Capitol Building Grant lands was placed under the State Capitol Commission. Powers of the State Board of Forest Commissioners were expanded in 1911 to include forest policy and management as well as protection.

The complete revision of land administration came in 1921 with the passage of the Administrative Code. Duties of the Board of Commissioners and the State Forester were vested in the new Department of Conservation and Development and its Division of Forestry. In addition, the Commissioner of Public Lands assumed most of the duties of the Board of State Land Commissioners. The State Capitol Commission was replaced by the State Capitol Committee.

The State Timber Resources Board, established in 1945, was the first major attempt to consolidate state grant and trust land management into one agency. The matter became controversial and was rejected by a referendum of the people in 1946. Except for aquatic lands the only state land not under control of the new board was University Grant land,

which was left to the University of Washington Board of Regents.

In 1951 a committee on state government organization was formed. In its first report it recommended a sweeping reorganization of public land management. A bill introduced in 1953 failed to gain support, but the committee's second report restated its conviction that a single forest and land management agency be created. This attempt was successful and in 1957 the legislature established the Department of Natural Resources to administer state grant, trust and aquatic lands (RCW 43.30.030).

A five-member Board of Natural Resources was formed to establish policies governing the department and to make necessary regulations to carry out their duties. The Board is comprised of the Governor; the Commissioner of Public Lands; the Superintendent of Public Instruction; the Dean of the College of Agriculture, Washington State University; and the Dean of the College of Forest Resources, University of Washington.

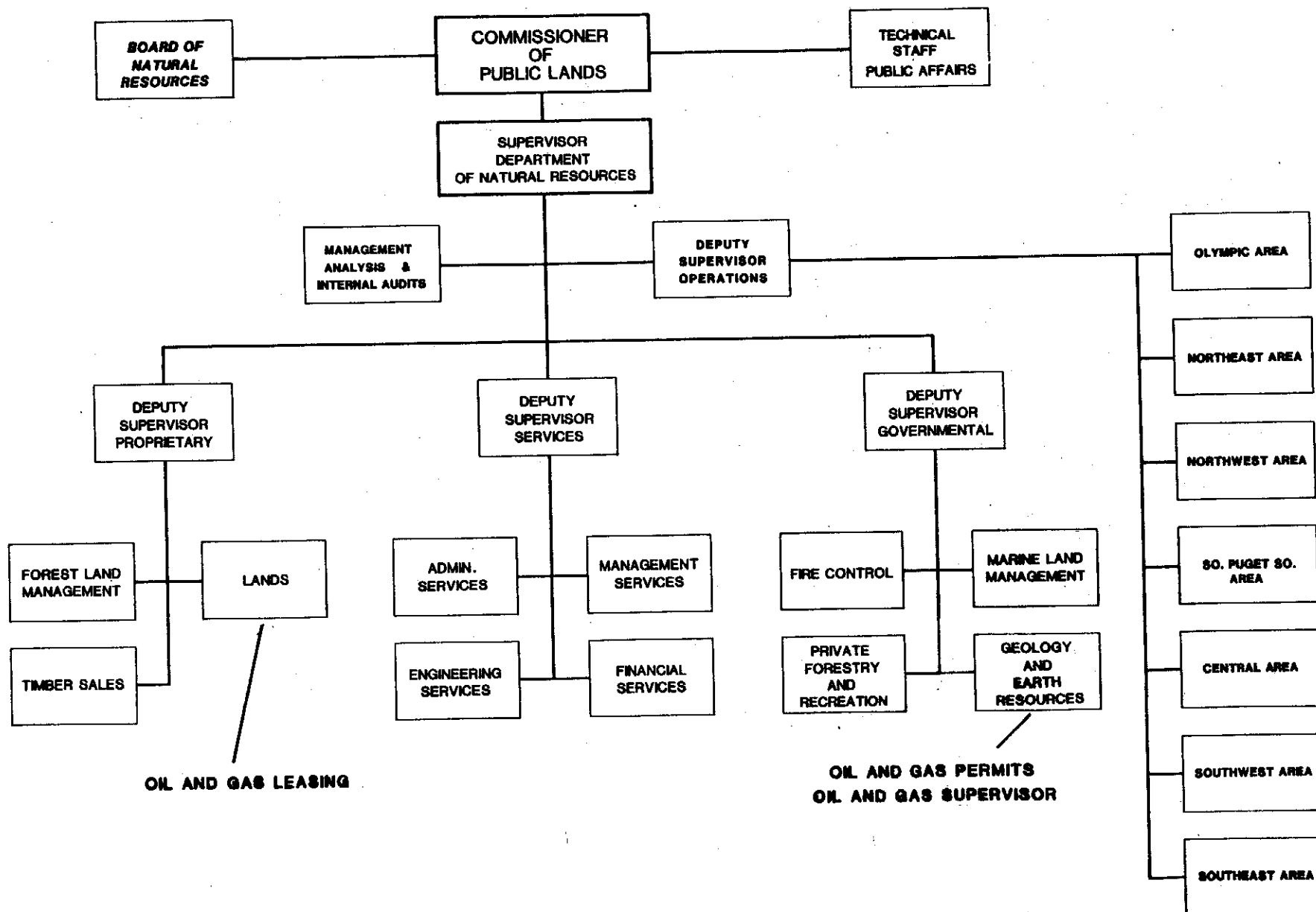
However, the department, not the Board, holds the principal decision making role on oil and gas leasing. The department promulgates rules and regulations and establishes lease terms and conditions (RCW 79.14.020 through .900 and Chapter 332-12 WAC). The Lands Division supervises proprietary activities and acts as lead agency for the oil and gas program fulfilling requirements of SEPA for uplands. The Marine Land Management Division fulfills the same role for aquatic lands. The Division of Geology and Earth Resources acts as the agent for the Oil and Gas Commission and as such carries out the requirements of

the Oil and Gas Conservation Act and the orders of the Committee.

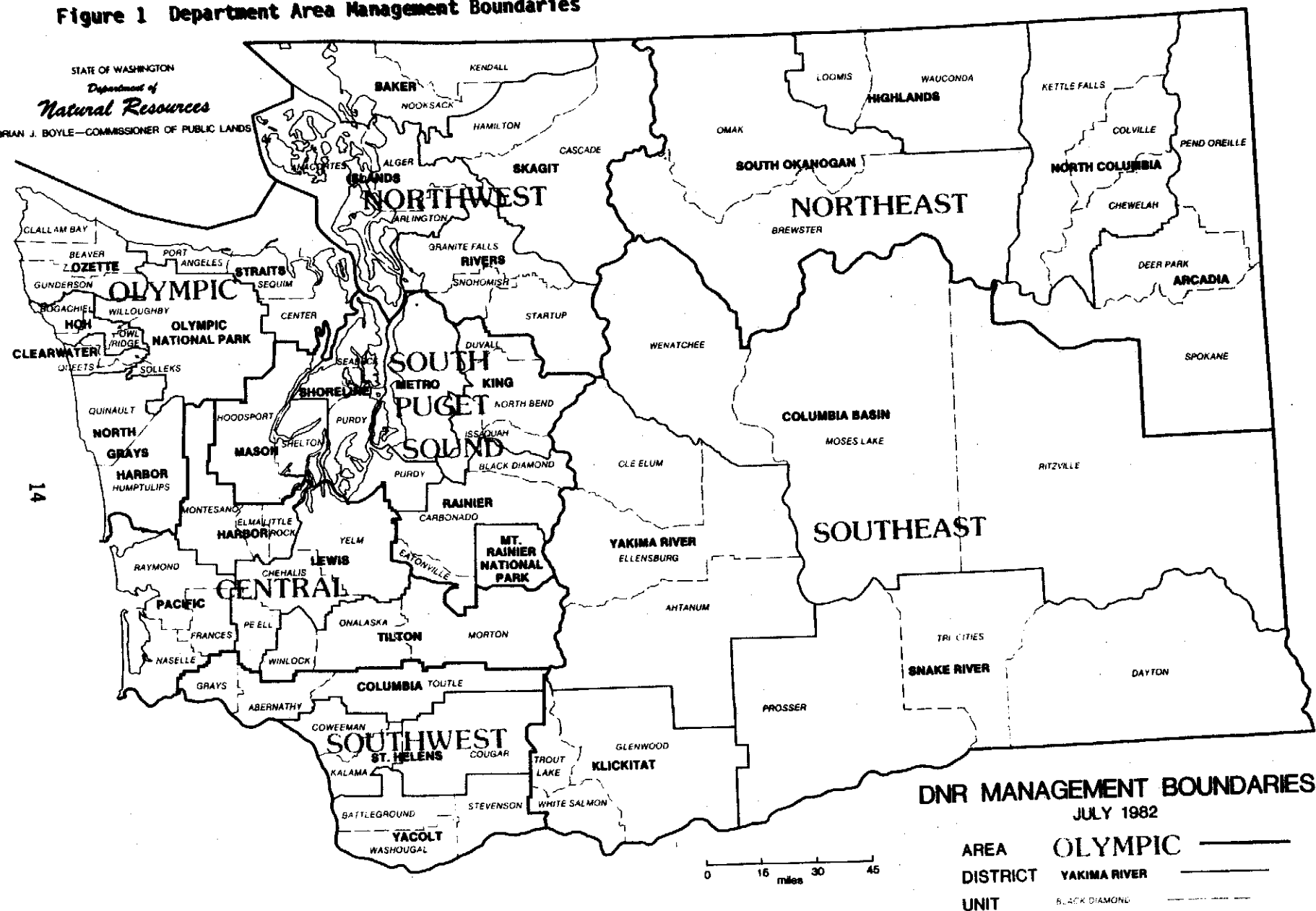
The diagram and map on pages 13 and 14 outline the operating structure of the

department. The divisions carry out the research and develop the programs. The Areas then put the programs into operation in the field.

Table 1 Department of Natural Resources Table of Organization



STATE OF WASHINGTON  
Department of  
*Natural Resources*  
BRIAN J. BOYLE—COMMISSIONER OF PUBLIC LANDS



## BOARD OF NATURAL RESOURCES/DEPARTMENT RELATIONSHIP

The Board of Natural Resources consists of five members: The Governor or the Governor's designee, the Superintendent of Public Instruction, the Commissioner of Public Lands, the Dean of the College of Forest Resources of the University of Washington and the Dean of the College of Agriculture of Washington State University (RCW 43.30.040). The Board of Natural Resources establishes goals and policies governing the department and makes necessary regulations to carry out department duties.

The Oil and Gas Leasing Program is strictly controlled by statutes and regulations. Therefore, the Board has not taken an active role in program administration.

The role of the Board is to:

- Review and adopt goals and policies for trust management programs, including the goals and policies contained in the Oil and Gas Leasing Program.
- Review and comment on a regular basis on the department's performance and plans for trust land management programs, including the Oil and Gas Leasing Program.
- Set minimum royalties as prescribed in RCW 79.14.030.

## OIL AND GAS CONSERVATION COMMITTEE/DEPARTMENT RELATIONSHIP

The purpose of the Oil and Gas Conservation Act is to foster, encourage and promote the exploration, development, production and use of oil and gas in the state in such manner as will prevent waste, assure maximum economic recovery of oil and gas and fully protect the rights of owners. The Act also ensures that such oil and gas operations are conducted in a manner that will maintain a safe and healthful environment for the people of Washington (RCW 78.52.001). This Act established a committee to oversee the oil and gas resources of Washington.

The Oil and Gas Conservation Committee is composed of seven members: The Commissioner of Public Lands, the State Treasurer, the director of the Department of Ecology and four residents of the state of Washington appointed by the Governor (RCW 78.52.020). The Committee administers and enforces

the provisions of the Oil and Gas Conservation Act by adopting policies, regulations and orders. The Committee is vested with jurisdictional power and authority over all persons and property, public and private, necessary to enforce the Act (RCW 78.52.040). The Committee participates in and administers the Federal Safe Drinking Water Act in conjunction with the Departments of Ecology, Natural Resources and Social and Health Services.

The Department of Natural Resources is the designated agent of the Committee. The department appoints a state Oil and Gas Supervisor (usually the Division of Geology and Earth Resources Manager) whose duties are determined by the department. The department may designate one or more Deputy Oil and Gas Supervisors and employ all personnel necessary to carry out the Act and orders of the Committee (RCW 78.52.037).

**INTRODUCTION  
TO  
OIL AND GAS  
EXPLORATION AND DEVELOPMENT  
IN WASHINGTON**



## HISTORY OF OIL AND GAS EXPLORATION

The first known oil well in the state was drilled around the turn of the century near Machias or Stanwood Station, Snohomish County. Since then approximately 435 oil and gas exploratory wells and 76 gas storage wells have been drilled in the state. Major companies drilled 110 of the exploratory wells. Thirteen wells have been drilled on state-owned land.

Less than one-fourth of the wells were drilled in Eastern Washington indicating the major interest has been in Western Washington. Extensive basalt flows and technological problems have prevented a thorough evaluation of the oil and gas possibilities in Eastern Washington.

### AREAS OF DRILLING ACTIVITY

The following areas have received the most extensive attention due to the presence of oil and gas seeps nearby, accidental discovery of gas in a water well or as a result of geological or geophysical information.

#### Columbia Basin

A small gas field ("Rattlesnake Hills Field") was discovered in 1913 when a company was drilling for water near Grandview in Benton County. This field produced nearly 1.3 billion cubic feet of gas from 1929 to 1941. At one time the field had 16 wells which produced from depths of 700 to 1,200 feet. During 1980 to 1984 three exploratory wells were drilled in Kittitas County; three other wells were drilled in the Columbia Basin, two in Grant County and one in Benton County.

#### Willapa Hills, Grays Harbor County

Drilling was initiated in 1901 and continued sporadically through 1977. Many

wells encountered oil and gas shows. In 1957 a producing well was drilled. This well ("Medina No. 1") produced 12,000 barrels of oil before being plugged and abandoned. This is the only well to date in the state to produce oil.

#### Olympic Mountains, Clallam and Jefferson Counties

Oil seeps were first reported in Washington about 1881 along the sea cliffs on the west side of the Olympic Peninsula. Outcrops of shale having a kerosene odor were also noticed along the beach on the western side of the peninsula. Natural gas seeps associated with mud cones and mounds have been reported in this same general area.

The area of interest is located in Clallam and Jefferson Counties on the west side of the Olympic Peninsula in the general vicinity of the town of Forks. Since the first well was started at the turn of the century, 33 exploratory wells and five core holes have been drilled in this area. The majority of these exploratory wells had shows of oil or gas. Seeps of both oil and gas have been known in this area. Minor drilling has taken place in Clallam County along the Strait of Juan de Fuca. Modest shows of oil and gas have been encountered in these tests.

#### Whatcom County

About five miles northwest of Bellingham in western Whatcom County gas in sufficient quantity for domestic use was obtained from glacial sand lenses at depths of less than 500 feet. More than 95 wells have been drilled; most were shallow.

### Puget Lowland

Although this area covers approximately 6,000 square miles it is being considered as a unit because of the similarity in rock strata, oil and gas environment and the broad drilling program. Approximately 95 wells have been drilled with shows of oil or gas in over half.

### Aquatic Lands

Exploration interest in lands on the continental shelf off Washington's coast

has remained fairly steady for a number of years. To date, six wells have been drilled in this area but no production has occurred.

Aquatic lands in every county abutting the ocean have been leased for oil and gas exploration in the past; 100,000 acres were leased in 1978. Two wells have been drilled on department aquatic lands; neither well was productive.

Interest has also been expressed in leasing aquatic lands under the Strait of Georgia, Strait of Juan de Fuca and the Columbia River.

## POTENTIAL AREAS OF OIL AND GAS INTEREST IN THE STATE OF WASHINGTON

Washington State is a substantial user of petroleum products but has not yet become a contributor to the supply, although over 435 wells have been drilled to date in search for petroleum with little or no commercial success. Only about one-fourth of the holes were located using modern technology.

Several sizeable areas within Washington State and on the adjacent continental shelf possess all of the major geologic characteristics that are required for the accumulation of commercial quantities of petroleum; for example, source rocks, reservoir rocks, proper structures and stratigraphy.

Considering the large areas involved, it can be calculated that less than one test well for every 200 square miles of favorable area has been drilled. Because of the complex structures and poor exposures of rock in Washington, exploratory drilling must be spaced much closer together before the favorable areas have been adequately tested.

### AREAS OF INTEREST

The order in which the following specific areas of interest are discussed does not imply a rating of the areas as to potential for exploration or interest.

#### Columbia Basin

The Columbia Basin occupies roughly the southeastern quarter of the state. It lies south of the Okanogan highlands and east of the Cascade Mountains and extends southward into Oregon and eastward into Idaho to the foothills of the Rocky Mountains. Surface geology, water wells and some oil and gas

exploration wells indicate the basin is underlain mainly by basaltic lava flows. Along the northern and eastern boundaries of the basin the basalt flows are underlain by igneous and metamorphic rocks generally of little interest to the petroleum industry. However, along the western margin of the basin, the basalts rest upon continental (nonmarine) sedimentary rocks and older lavas. These sediments contain coal beds in the Roslyn-Cle Elum area and extend eastward under the basalt flows for an unknown distance. Marine strata in north central Oregon are known to occur and may extend northward into Washington. In the western part of the Columbia Basin, the subsurface rocks may possibly hold hydrocarbon potential if the structural conditions prove favorable.

In spite of the extensive amount of basalt which occurs in the Columbia Basin, oil and gas shows have been encountered. The Rattlesnake Hills Field mentioned earlier was discovered near Grandview in Benton County. Wells drilled in other areas of the basin have produced shows of gas. Wells drilled in 1981-82 in Kittitas County reportedly contained substantial although subcommercial shows of gas. Oil and gas leasing and exploration activities continue in the Columbia Basin area.

#### Willapa Hills

The Willapa Hills and adjacent areas of southwestern Washington include all the territory south of the Olympic Mountains and west of the Puget Lowland, an area of approximately 3,500 square miles. Here strata have potential source beds for petroleum generation and potential reservoir rocks for

petroleum accumulation. These rocks have been tested locally and excellent indications of petroleum have been found. Subcommercial production has been obtained in four wells. Numerous wells have been drilled on favorable geologic structures located in the area. This area continues to attract the interest of the oil and gas industry and will probably continue to receive exploration interest.

### Olympic Peninsula

The Olympic Peninsula has continued to interest the industry over the years, particularly along the north flank of Clallam County, along the Strait of Juan de Fuca and in the western part of the Peninsula near the community of Forks and the mouth of the Hoh River. On the north side of the peninsula a section of strata of more than 15,000 feet has yielded petroleum shows in some wells. Additional exploration activities can be anticipated for this locality. The central core of the Olympic Mountains consists of rocks that presumably have little petroleum potential and are classified as unfavorable.

### Whatcom County

In western Whatcom County, gas in sufficient quantity for domestic use has been obtained from glacial sand lenses at depths of less than 500 feet. To date, more than 90 wells have been drilled. Most of the wells reported gas shows. A few reported oil shows. The industry continues to show interest in this area and more exploratory activity can be expected in the future.

### Puget Lowland

The Puget Lowland, including much of the area between the Olympic Mountains

and the Cascade Range, has for some time been regarded as potentially favorable for oil and gas production. Unfortunately, much of the lowland is covered with glacial deposits, making exploration difficult. However, new techniques being developed will help solve this difficulty. Much exploration is required in this potentially favorable area before it will have been adequately tested.

Surface geologic mapping has delineated several structures and faults in the Puget Lowland and geophysical investigations have outlined a few deep structures in the basin. Considerable drilling on the surface structures has been done in central Lewis and western King Counties. Oil traces or shows have been reported in 14 tests and gas shows reported in 16 others.

### Aquatic Lands

Aquatic lands on the continental shelf include both state (from the coastline seaward for three nautical miles) and federal (beyond the three-nautical-mile line) land. Sedimentation basins of the continental margins of the Pacific Northwest are considered by some to hold great potential for oil and gas production.

Continuous seismic profiling surveys indicate that structural and stratigraphic conditions in this large area are favorable. However, only a minor amount of drilling has occurred and many favorable geologic structures on aquatic lands remain unexplored.

### SUMMARY

Exploratory test wells in the state of Washington have disclosed evidence of petroleum and natural gas in more than 100 wells but only minor production has

been obtained. The state contains areas that possess the three geologic features that are required for the accumulation of commercial quantities of petroleum and natural gas. These are:

1. An adequate source of petroleum-generating material in the form of abundant marine animal or plant life.
2. The presence of reservoir rocks in which important amounts of oil and gas can accumulate and from which they can be made to flow to wells

for production at satisfactory rates.

3. Suitable structural or stratigraphic conditions that provide a means of localizing and entrapping the oil or gas in the reservoir rocks.

Whether these three factors will be found in a combination that would provide major commercial production of petroleum or natural gas has yet to be determined although surface and subsurface indications are favorable in many areas.

## PHASES OF ACTIVITY

Major phases of activity in the oil and gas industry as they relate to this program are: Exploration, Development and Production, and Reclamation.

1. Exploration -- This phase includes all activities conducted by an operator or company from the decision to investigate an area through preliminary evaluation. They are:
  - Surface geologic mapping, geophysical mapping including explosive seismic surveys;
  - Land and lease evaluation;
  - Stratigraphic test hole drilling;
  - Exploratory drilling; and
  - Reclamation -- plugging and abandonment of drill holes, removal of waste materials, closing of access roads and site restoration.
2. Development and Production -- This phase is one of intense activity if oil and gas are found in commercial quantities. It requires:
  - Drill site development;
  - Construction of flow and gathering lines, storage, processing and treatment facilities;
  - Production;
  - Maintenance of facilities;
  - Waste disposal - at approved sites, or in the case of fluids into approved strata containing waters of equal or lesser quality (in conformance with the

Underground Injection Control Program of the Federal Safe Drinking Water Act); and

- Reclamation - site cleanup, removing unnecessary structures and plugging wells as they become unnecessary to development and production.
3. Reclamation -- This is the final abandonment phase and includes:
    - Plugging and abandoning of production and injection wells;
    - Removing all surface facilities;
    - Restoring the site; and
    - Closing and reclaiming haul and access roads.

### EXPLORATION

#### Geophysical Mapping, Exploration or Surveys

The exploration phase uses a wide range of scientific research methods to locate possible oil and gas bearing strata. Geophysical surveys normally are conducted before an oil and gas lease is obtained, but are not necessarily requisite to obtaining a lease. The operator or company decides where geologic and geophysical mapping is to be conducted.

Geophysical surveys may be conducted after a lease is obtained or after exploratory drilling to further delineate the structures and strata at

depth. The procedures are described here to provide an overview of administrative activities relating to such surveys.

Geophysical surveys such as gravity and magnetic can be conducted from existing roads and trails or from air borne equipment. Seismic surveys, one of the more frequently used methods of geophysical investigation, occasionally require the clearing of new access trails or roads and the movement of heavy equipment.

In seismic surveys, a sound wave is sent into the subsurface and the time required for the wave to travel to and return from a subsurface horizon is recorded. (See Figure 2.) Interpretive maps can be drawn from an analysis of the differences in time it takes the wave to be reflected back to the surface from the various rock formations. Explosive, vibrator or thumper methods are used to produce the sound wave. In the explosive method, generally shot holes are drilled to a depth of between 50 and 200 feet deep with 1 to 12 holes per mile and loaded with 5 to 50 pounds of explosive and detonated. The same hole is occasionally loaded and shot several times to find the depth and explosive charge returning the best reflection or refraction signal. The vibrator and thumper methods pound or vibrate the earth to create a sound wave. Thumper surveys are not commonly used (personal communication, Larry Bowles, International Assoc. of Geophysical Contractors).

The sensors and energy sources are located along straight lines laid out on a 1- to 2-mile grid. The energy sources are normally truck mounted and constitute heavy equipment. Existing road systems are used where available. Lines may be cleared of vegetation and loose rocks to improve access for the trucks. Each mile of line cleared to a width of 8½ feet uses 1 acre of land.

### Stratigraphic Test Holes

Stratigraphic test holes are drilled to depths of less than 2,000 feet to locate geologic indicators. The holes are usually drilled with truck-mounted equipment and disturb a relatively small area. Stratigraphic holes are cased in areas of shallow, high pressure zones or where otherwise required by the Oil and Gas Supervisor. The roads and trails constructed for access are temporary and involve minimal construction. The drill site occupies approximately 900 square feet and is sometimes placed in the center of an existing trail or road.

### Exploratory Drilling

Exploration begins with company geologists reviewing geological and technical data available from the region. Seismic shot holes, stratigraphic test holes or exploratory wells (wildcat) are drilled on a very small percentage of the areas involved in preliminary investigations. Exploratory drilling does not begin until a lease has been acquired by the operator. Washington State, through the Oil and Gas Conservation Committee, regulates exploratory drilling.

### Wildcat Wells

Wildcat wells are deeper tests (usually over 2,000 feet) and require larger drilling rigs with support facilities. They may disturb a larger surface area than stratigraphic tests. (See Table 2.) Required facilities include roads, drill pads, mud pits and, in rare instances, camps.

After a drilling site has been selected, a heavy-duty road is constructed to move the drilling rig and other equipment to the location if existing roads will not suffice or roads do not exist.

Figure 2 Seismographic Testing

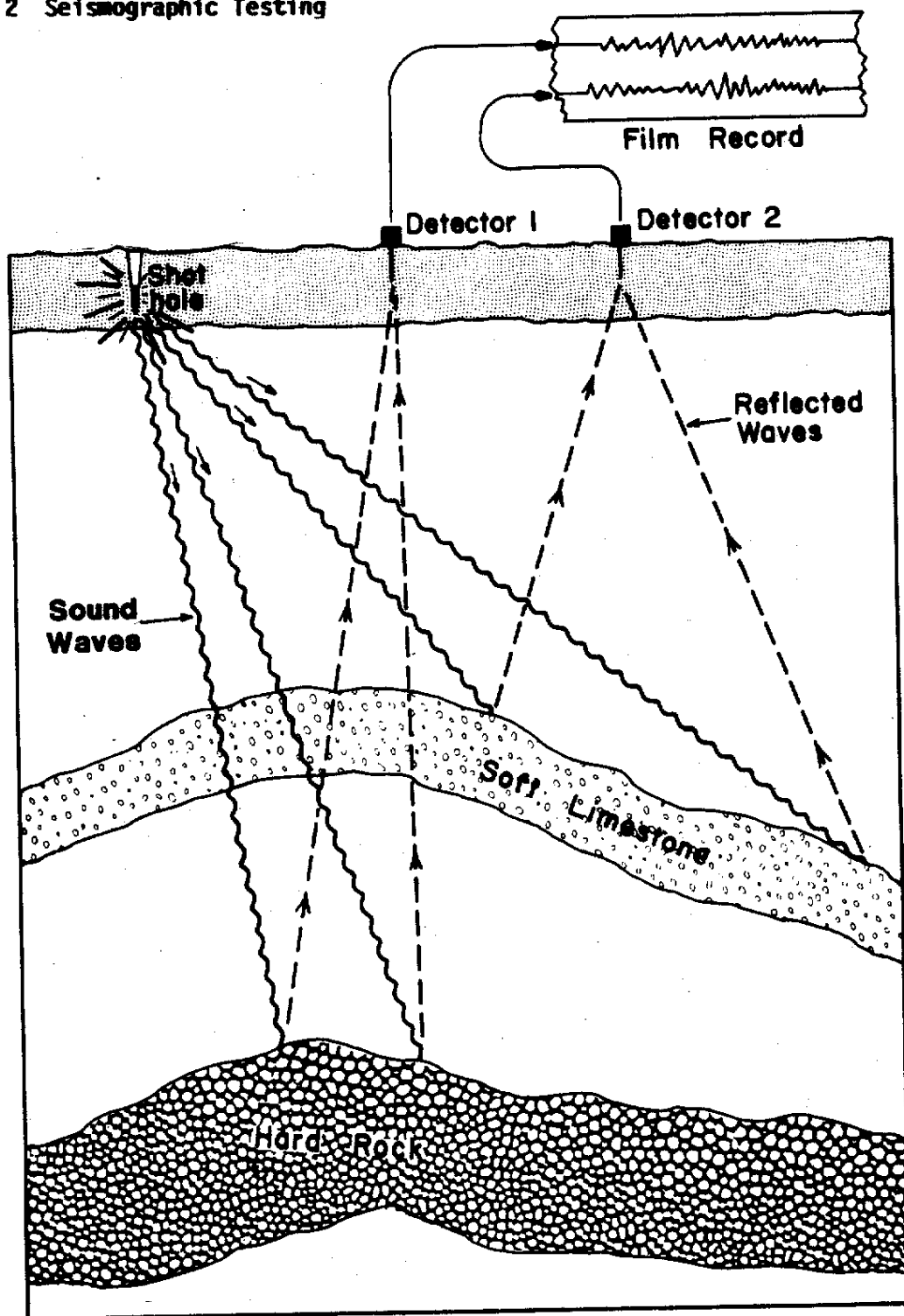




Table 2 Estimated Acreage Requirements Within a Lease Section  
for Gas or Oil Development.

	Well Spacing	
	1 Well Per Section*	4 Wells Per Section†
Drill Pad	4 acres‡	16 acres‡
Roads (18 ft. wide)	2.2 acres (1 mi. required)§	4.4 acres (2 mi. required)**
Pipelines (corridor 25-50 ft. wide)	3-6 acres (1 mi. required)#	6-13 acres (2 mi. required)**
Central collection, separation, and storage facilities	Unable to determine at this time.	

\* Probable gas development spacing. Minimum spacing per RCW 78.52.210

† Probable oil development spacing. Minimum spacing per RCW 78.52.210

‡ Half of this acreage would be rehabilitated upon completion of drilling activity. The remaining acreage would be rehabilitated upon abandonment.

§ Could vary from approximately 1.1 - 3.3 acres (.5 - 1.5 miles of road) depending on position of well in section and topography.

# Could vary from approximately 1.5-9.1 acres (.5-1.5 miles of pipeline) depending on position of well in section, topography and width of pipeline corridor.

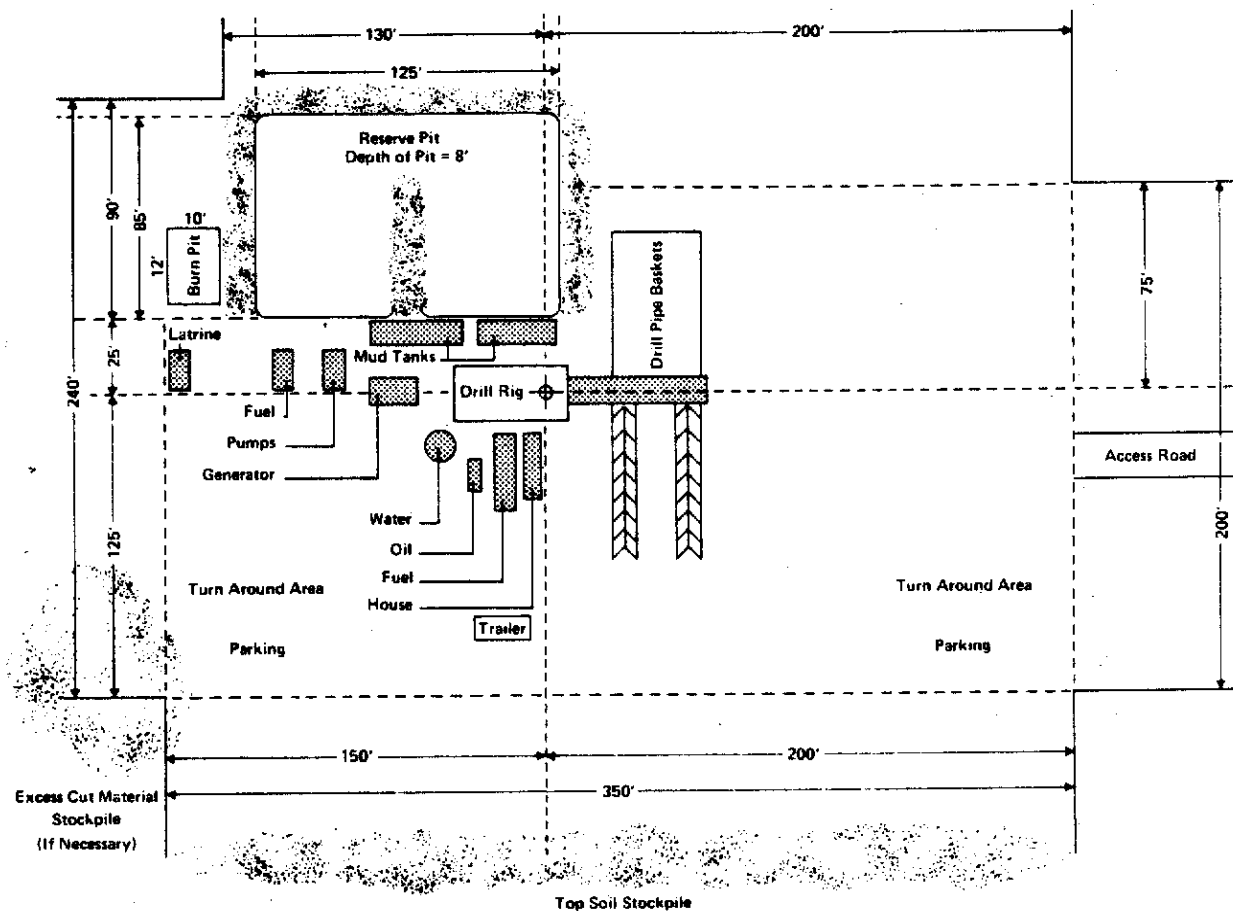
\*\* Minimum required.

The well site may occupy one to four acres and is cleared of all vegetation and graded nearly flat. Depending on the soil in the area, the well site or drill pad and roads may or may not be graveled. A concrete cellar or sub-structure is constructed to serve as a base for the blowout prevention equipment and as a support for the rig. In addition to the drill rig, mud pumps, a mud pit, generators, pipe racks, a tool house and personnel office

trailers are located on the drill pad (Figure 3 and 4). Other facilities such as storage tanks for water and fuel may be located on or near the drill pad.

A water supply is required for mixing drilling mud, cleaning equipment, cooling engines and other uses. The water may be trucked in to the site or a pipeline may be laid to a pump installed in a stream or to a water well.

**Figure 3 Location Layout for a Well 6,000 to 9,000 Feet Deep**

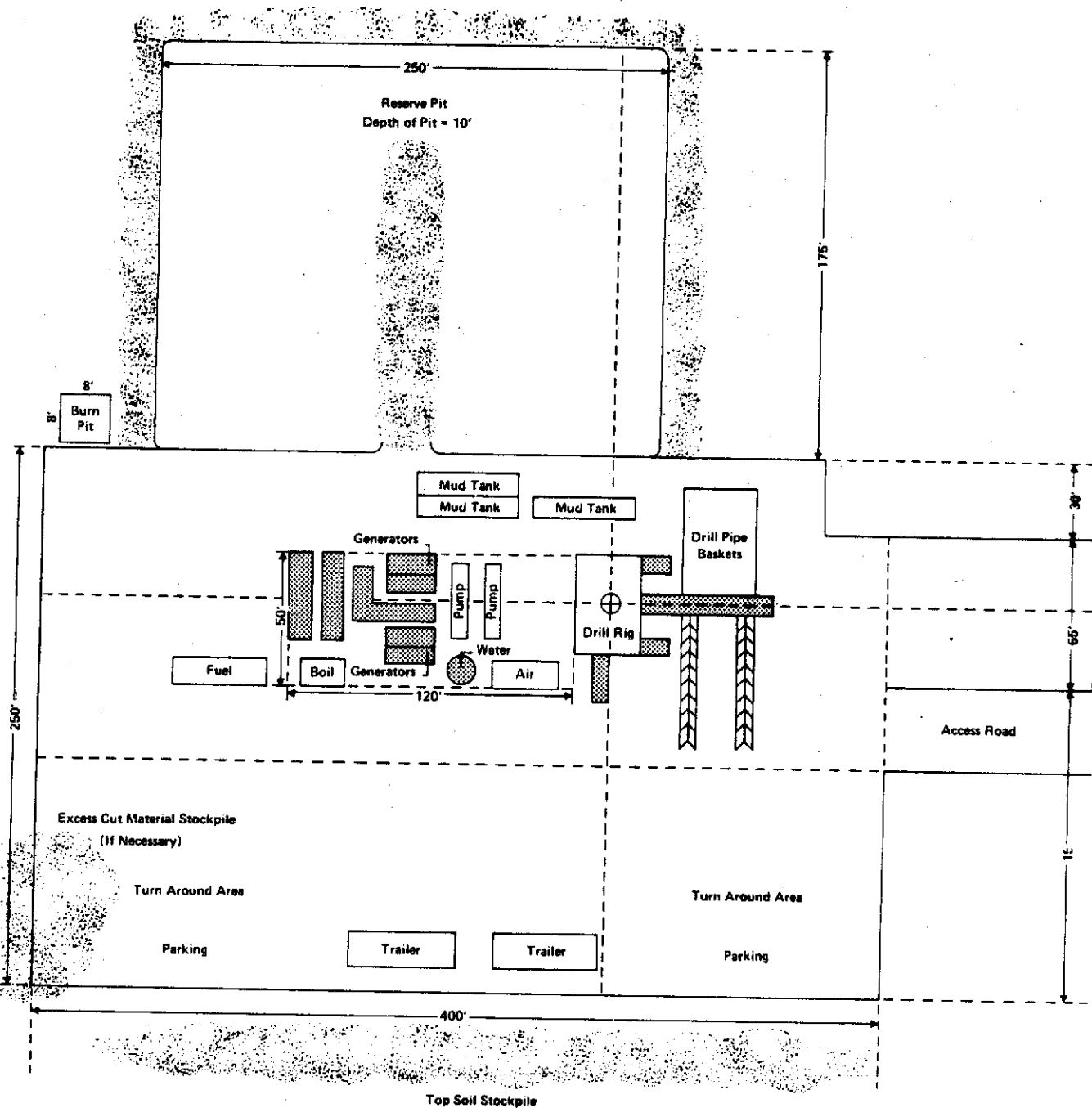


Source: U.S. Dept. of Interior, 1980a.

Oil and gas field drilling practice requires setting conductor pipe to a depth of 15 or more feet to keep surface materials from sloughing into the well. Surface casing is set to a depth deemed necessary by the Oil and Gas Supervisor to protect any fresh water zones and to keep the well from blowing

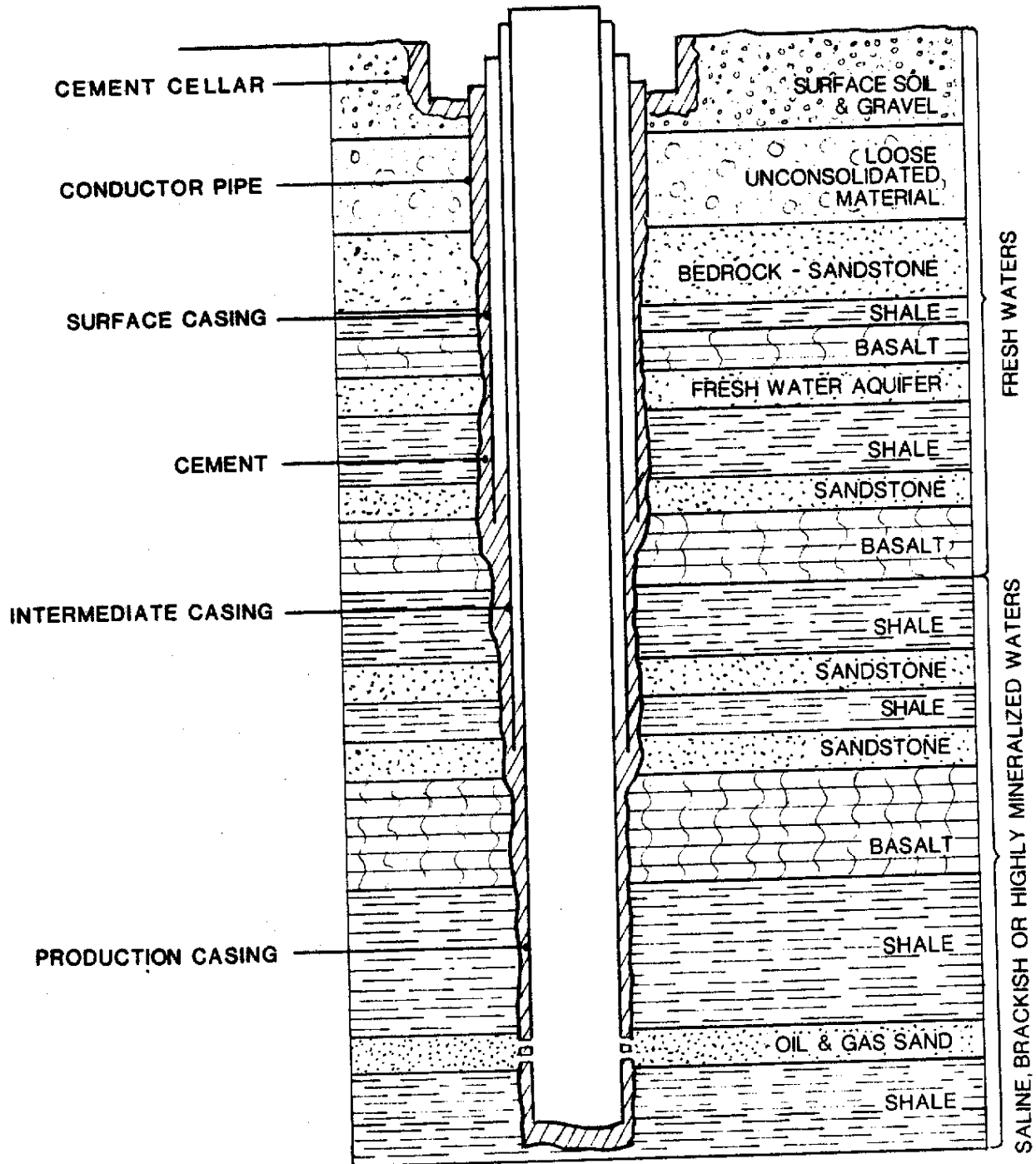
out in the event a high pressure zone is encountered. As the well deepens the drilling crew adds additional joints of drill pipe to the top of the drill string. Additional strings of intermediate casing may be necessary to protect the drill hole from sloughing or blowout. (Figure 5.)

**Figure 4 Location Layout for a Well 9,000 to 15,000 Feet Deep**



Source: U.S. Dept. of Interior, 1980a.

Figure 5 Oil/Gas Well Casing



The physical and chemical characteristics of the drilling mud are maintained to cool the drill bit, reduce drag of the drill pipe on the sides of the well bore, seal off any porous formations, contain formation fluids to prevent a blowout or loss of drilling fluid and bring the drill cuttings to the surface for disposal. Various additives are used to maintain the drill mud at the proper viscosity and weight.

Some of the additives may be caustic, toxic or acidic. Others are simply inert weight and fluid additives. Requirements may be placed on the transport of additives to and from a drilling site. The drilling permit may contain clauses to preclude the use of toxic or acidic additives if site conditions warrant it. When applying for a permit to the Oil and Gas Conservation Committee the operator must specify what additives will be used. Drilling mud materials are listed in Appendix A.

Storage tanks are required to hold oil produced from an exploratory well. A separator may be required to separate the oil and gas. If water is produced with the oil, a treater may be needed. When water is produced along with oil and/or gas it may (subject to approval) be disposed of by injection into the producing formation, by injection into another formation containing water equal to or of lesser quality than the produced water or (depending on quality) be allowed to evaporate from a surface impoundment or disposed of in streams. Gas separated from the oil may be burned off (flared) as waste during the initial stage of oil field development. If gas is discovered, only that amount of gas necessary to determine the well's capacity is permitted to be flared. The well is shut-in until the gas line is constructed.

Well completion requires installation of steel casing inside the surface casing projecting down to or through the pay (production) zone. The casing is selectively cemented to provide adequate anchoring and stability and to protect specific zones. The drilling rig and most of the support equipment are usually removed from the well site after the casing is cemented. The completion of a wildcat well as a commercial producer usually marks the beginning of the development phase.

## DEVELOPMENT AND PRODUCTION

A development unit (well spacing or pattern) must be established under the provisions of Chapter 78.52 RCW and Chapter 344-12 WAC before development drilling begins. The development unit is determined by the Oil and Gas Supervisor after public hearings. RCW 78.52.210 sets a maximum of 160 acres for an oil reservoir and 640 acres for a gas reservoir.

Current Washington law (RCW 78.52.210) sets a maximum spacing of 160 acres per oil well. Minimum spacing probably will not be less than one well per 40 acres, with each well separated by one-fourth mile. With 40-acre spacing (16 wells per square mile) approximately four miles of access roads and four to six miles of flow lines connecting wells and tank battery would be required.

Surface uses for a gas field would be significantly less than in an oil field. Gas wells can be spaced from one per 160 acres down to one well per 640 acres. A 160-acre spacing would require four wells per section and two miles of access roads and pipelines. Separation and storage facilities are not required for gas production unless the production is rich in liquids or condensate. Gas may be sold without separation at the production site.

The procedures used in drilling development wells are the same as those used for a wildcat well. Additional surface facilities required for development drilling may include access roads, well sites, flow lines and storage tank batteries; and facilities to separate oil, gas and water. Remote locations may require camps and heliports, but this is unlikely in Washington.

Well facilities in oil fields vary depending upon whether the well is a flowing or pumping well. Pressures in some oil reservoirs are great enough to force oil to the surface. This results in a flowing well. Most oil wells in the United States will require the use of some means of artificial lift to bring the oil to the surface. Pumping and a technique known as "gas lift" are the two methods of artificial lift used at present. Flowing wells and wells with gas lift facilities require a minimum of equipment at the surface and produce little or no sound. All pump systems require more surface equipment.

The surface equipment at the head of a flowing well consists of the well head equipment or "Christmas tree" (a series of valves and pipe connections connecting the well head to the flow lines). The area around the well head and pipe connections is fenced. The area required ranges from 15' by 15' to 50' by 50'.

Over 90 percent of the oil wells in the United States in 1971 were on artificial lift and most artificial lift wells use sucker rod pumps. Other pumps used on oil wells are hydraulic and centrifugal pumps. All of the pump systems require some surface equipment and fuel or electric power lines. All generate some noise, ranging from almost none for electric motors to high noise levels for single cylinder gas engines.

Gas lift is used in some oil fields where low cost, high pressure natural gas is available and where pressure in the petroleum reservoir is sufficient to force the petroleum part of the way up the well. The addition of gas lowers the specific gravity of the petroleum so that it flows to the surface. The system is quiet and uses little ground.

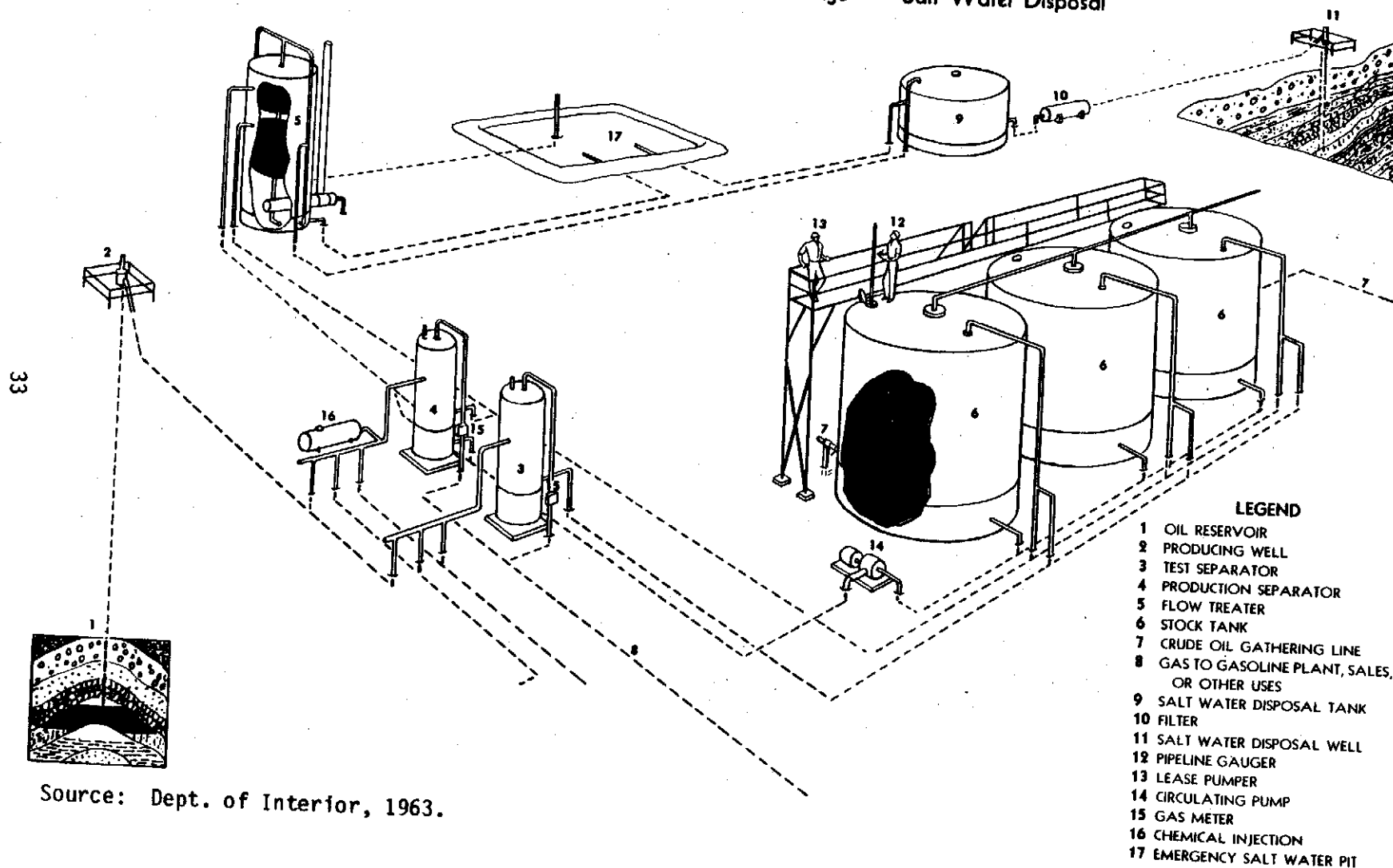
Most gas wells produce by normal flow and do not require pumping. Surface use at a flowing gas well usually is limited to a 20' by 20' fenced area. If water enters a gas well and chokes off the gas flow, a pump may be installed to pump off the column of water.

Oil and gas are transferred from the wells to central collection points and flow lines. The flow lines usually are three- or four-inch diameter steel pipes. They may be buried, installed on the surface or elevated. Flow lines transfer crude oil from the wells to a central collection point, or storage tank battery (two or more), before the oil is transported from the lease (Figure 6). Natural gas is often sold at the well head and transported directly off the site via pipeline. If processing is required to remove liquid hydrocarbons or water, the gas may be transferred to a central collection point prior to sale.

There are various separating, treating and storage facilities involved in oil and gas production. If the fluids produced at the well contain gas and water, the oil, gas and water are separated before the oil is stored in the tanks. The tanks are usually located on or near the lease. Small leases may contain only one tank battery; large leases may contain several. Each battery contains separating, treating and storing facilities.

Figure 6 Flowing Oil Production

Well and Flow Lines • Separation and Storage • Salt Water Disposal



Source: Dept. of Interior, 1963.

Although most water produced with oil and gas is brackish to highly saline, some produced water is fresh enough for beneficial surface use. Saline water is usually disposed of by subsurface injection. Evaporation pits may be used in arid regions where evaporation rates are high, such as the Columbia Basin.

When surface water is disposed of underground, it is introduced into a subsurface horizon containing water of equal or poorer quality. The disposal of any water underground must comply with the provisions of the Oil and Gas Conservation Act, Underground Injection Control regulations of the Department of Ecology and the Underground Injection Control provisions of the Federal Safe Drinking Water Act developed to protect freshwater aquifers.

Primary production of oil occurs when energy in the reservoir is sufficient to drive the oil to the well. When natural reservoir energy sources are inadequate or have become depleted, secondary production methods involving gas or liquid injection may be used to supplement the natural forces. Secondary techniques for improving oil recovery may involve one or more of the following techniques: Water flooding, miscible flooding, fire flooding, steam flooding and natural gas injection. Natural gas also is injected into some oil reservoirs during primary recovery as a pressure maintenance program.

Water flooding is the injection of water under pressure into the reservoir to drive additional oil to the producing wells. This is probably the most commonly employed form of secondary recovery. A successful water flood may increase recovery approximately 100 percent. In miscible flooding, chemical compounds, including detergents, are injected into the reservoir to break down the oil molecule or

reduce viscosity. Fire flooding involves initiation of a controlled fire in the reservoir with the resulting heat and increased pressure forcing the oil to the well. Steam flooding is used to reduce the viscosity of the oil to permit it to flow more readily to the well. Some of the techniques have been used for tertiary recovery after a water flood.

In some gas condensate reservoirs, some of the components of a gas condensate into liquid form near the well bore when production reduces pressure in the reservoir. The resulting reduction in pressure may cause a significant loss in recovery. To prevent this, gas is injected to maintain pressure above the lower condensation pressure.

### Directional Drilling

Directional drilling is the intentional deviation of a wellbore from the vertical. Although wellbores are normally drilled vertically, it is sometimes necessary or advantageous to drill at an angle. Controlled directional drilling makes it possible to reach subsurface areas laterally remote from the point where the drill enters the earth. For example, directional drilling is used to drill from convenient and accessible locations to bottom beneath locations impossible or inaccessible for normal drilling sites, such as:

- Steep, mountainous terrain,
- Unstable land,
- Swamps, rivers, lakes and
- Residential areas.

In directional drilling the average rate of variation from the vertical is 5 degrees per 100 feet of hole drilled.



Some holes have been drilled at a rate of variation of 6 to 8 degrees per 100 feet. The maximum drift angle that can normally be maintained is 80 degrees. However, angles as high as 90 degrees have been reported. Two types of directionally drilled holes are used. In one the drift angle is increased at a uniform rate to the desired maximum deflection angle until the target depth is reached (Figure 7A). In the other the drift angle is increased at a uniform rate until the maximum deflection angle is attained, then the wellbore is brought back to vertical (Figure 7B). The capabilities of directional drilling are illustrated by a well drilled in California which had the bottom of the well displaced 9,882 feet horizontally from the surface location (Figure 8). (See page 36 for Figures 7 and 8.)

## RECLAMATION

### Exploration

Reclamation of stratigraphic test holes and dry wildcat well sites begins with plugging and capping the well. The drilling rig is used to plug the hole and then removed. The casing is cut off below normal cultivation depths. Drilling fluids and cuttings uncontaminated by toxic additives may be disposed of in the mud pit at the site (subject to approval from the Oil and Gas Supervisor).

Contaminated fluids and cuttings are transported to a DOE-approved disposal site. The drill pad surface, including the reserve mud pit, is restored to its original condition insofar as possible. Access roads are reclaimed as required by DNR or surface owners. The state or surface owners may retain access roads for future use.

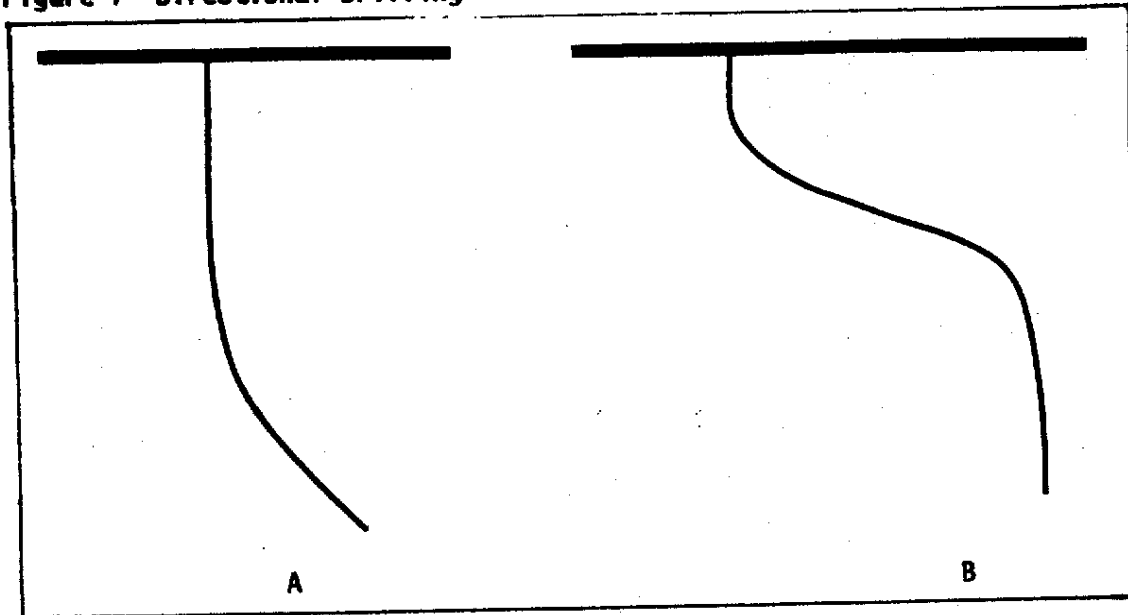
### Development and Production

Production wells and injection wells are plugged and capped after the lessee demonstrates the well's unsuitability for further profitable production. In some cases, wells are plugged as soon as they are depleted. In other cases, depleted wells are not plugged immediately, but are temporarily capped and allowed to stand idle for possible later use in secondary recovery operations.

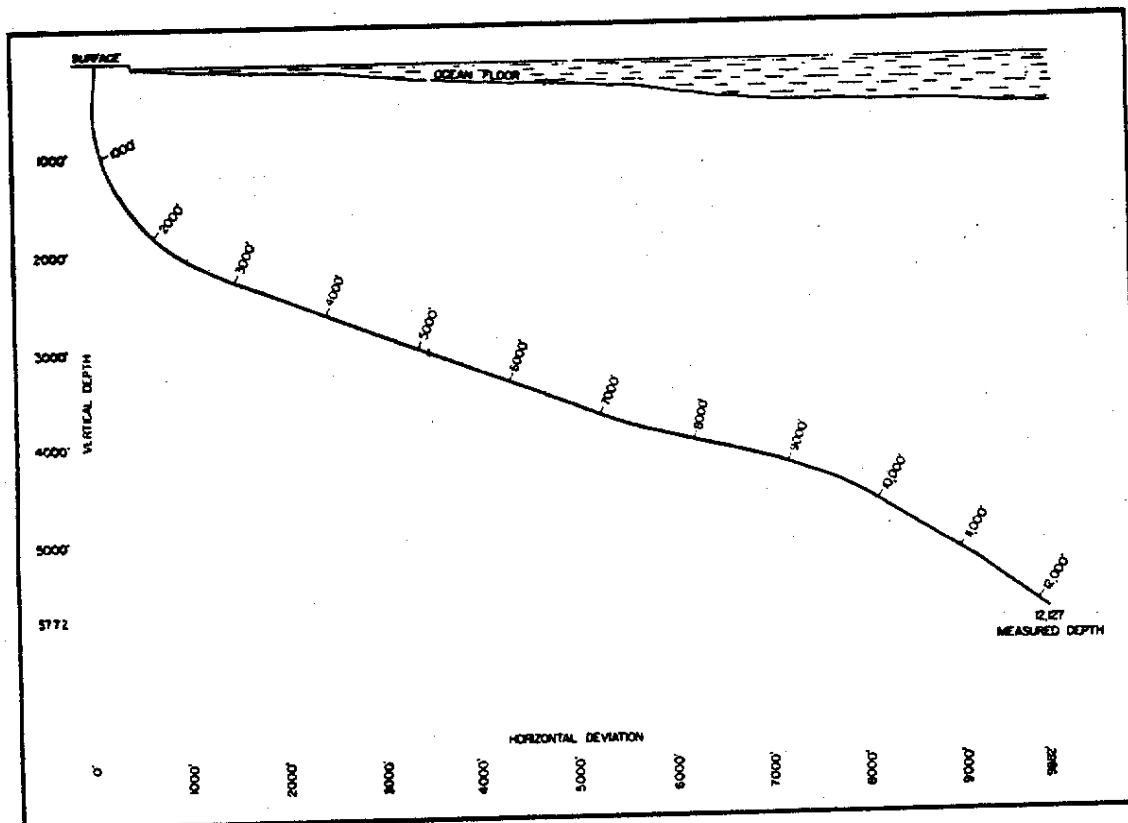
## LEASE ABANDONMENT

When an entire lease is abandoned, all surface facilities, including separators, treaters, tanks and other processing and handling equipment are removed and the surface is restored. Flow lines and injection lines installed on the surface are removed, but buried lines usually are left in place. The surface is restored to its original condition insofar as possible. Access and haul roads are restored.

**Figure 7 Directional Drilling**



**Figure 8 Example of Possible Horizontal Displacement**



**DEPARTMENT OF NATURAL RESOURCES**

**OIL AND GAS**

**LEASING**

**PROGRAM**

## INTRODUCTION

The management of state-owned land is a complex process that requires gathering information for decision making, incorporating management concerns, taking advantage of opportunities, protecting resources, allowing for change, gathering public and agency input, meeting legal and trust obligations and achieving proper land and resource use.

To make the oil and leasing process effective, the department is committed to:

1. Involve the public, interested agencies and industry in planning and decision making.
2. Use professionals in the fields of oil and gas leasing, exploration and development; fisheries; wildlife management; and other resource areas to assist in the oil and gas leasing process.

This program is available to the public, other agencies and industry. Future changes will be submitted for review and comment in accordance with SEPA.

Professionals within the department, other agencies and the private sector will be used as necessary to ensure proper controls are used to obtain maximum returns to the state, promote the oil and gas resources of the state and maintain adequate safeguards to protect the environment.

The Oil and Gas Leasing Program will set the general guidelines and controls for oil and gas leasing and exploration of department-managed lands. Activities permitted under normal leasing and those restricted or prohibited under restricted leasing will be prescribed.

Initial planning and environmental review will require consideration of the following elements:

### Natural Resources

Land (acreage)  
Soils  
Geology  
Water (surface and subsurface)  
Flora  
Fauna  
Wildlife habitat  
Cultural resources

### Conditions

Land ownership distribution  
Soil Stability  
Aquifers  
Oil and gas leasing on adjacent lands  
Land use plans  
Topography  
Climate  
Existing land uses  
Statutes, regulations and zoning

The department is developing a system that will receive and catalog data needed for the Oil and Gas Leasing Program. Due to budget and personnel limitations a comprehensive up-to-date inventory of the elements is not currently available. The department will rely on field inspection and information

from other agencies and the public until the Geographic Multiple Use Analysis and Planning System (GEOMAPS) is operational. GEOMAPS is described more fully in the department's Forest Land Management Program (DNR, 1983a). New information, as it becomes available, will be added to the system.

## REVENUES

Revenues from oil and gas leasing consist of application fees, rental fees and bonus bids, and may include royalties. Oil and gas leases are issued through public auction to the person submitting the highest cash bonus bid.

The Board of Natural Resources establishes rental fees and royalties. The minimum annual rental is \$1.25 per acre. The minimum royalty is \$5 per acre per year or 12½ percent of gross production whichever is greater (RCW 79.14.070). The department distributes the revenues received to the appropriate trust, fund or county as required by statute.

Income from oil and gas leasing varies annually according to the level of interest of the oil and gas industry and speculators. No reliable projections can be made for financial planning purposes due to the variability of interest in leasing. For illustration, during the period of 1974

to 1982 annual income from rental fees ranged from \$1,548 to \$632,258. Bonus bid revenues ranged from zero to \$3,827,100. Revenue projections may be more feasible if commercial production of oil and gas is established.

### RELATIONSHIP OF OIL AND GAS REVENUES TO OTHER TRUST LAND REVENUE SOURCES

If oil and gas activities should occur, revenues from forest production, agriculture and grazing, etc. may be temporarily reduced. The temporary loss of revenues from those sources may be offset by increased rental fees, bonus bids and royalties.

Unless the department elects to directly dispose of the forest products, forest products on rights of way over public lands and the land necessary for the drilling operation shall be appraised by the department and paid for by the lessee. (RCW 79.14.140 and WAC 332-12-430.)

## POLICIES

All procedures required by law are department "policy". Laws applicable to the Oil and Gas Leasing Program are too numerous to state as individual policies, however Revised Code of Washington (RCW) and Washington Administrative Code (WAC) reference numbers are given throughout this program.

### LANDS AVAILABLE FOR LEASE

All department-managed lands are available for oil and gas leasing. However, some lands are unavailable because of existing laws, regulations or by order of the Commissioner of Public Lands. No applications will be accepted on such lands and the applicant will be informed of the determination early in the administrative process.

Some lands nominated by the applicant may already be under surface lease for activities such as grazing, forest production, agriculture and residential use. Oil and gas activities could pose significant adverse environmental impacts to the surface lessee's operation. Lease applications will be accepted only for those tracts where it is anticipated that no significant adverse impacts will occur.

The SEPA process and the department's Sensitive Area Planning process may identify other lands that will be withheld from leasing. This decision will be based on site-specific conditions.

### LANDS AVAILABLE FOR CONDITIONAL LEASE

The State Owns the Surface and Mineral Rights but the Surface Rights are Leased for Other Purposes

The leases may involve parks, wildlife refuges, municipal watersheds, department-managed aquatic lands, cities, towns and residential areas. These lands may be leased for oil and gas purposes but entry, seismic exploration and drilling may be prohibited. Directional drilling from adjoining lands may be permitted subject to the Oil and Gas Conservation Act (Chapter 78.52 RCW and WAC 344-12-078) and other applicable laws and regulations. The determination to permit any activity will require completion of an Environmental Checklist and, if necessary, submission of mitigating measures acceptable to the department and the surface user.

### The State Owns the Mineral Rights but has Relinquished the Surface Rights

Lands on which the state owns the mineral rights but does not own the surface rights may be leased for oil and gas purposes but entry, seismic exploration or drilling are prohibited unless the lessee (prior to commencement of any operation) secures consent or a waiver from the surface owner or provides full payment for damages or provides surety or institutes action in Superior Court of the county in which the lands are situated (RCW 79.14.040). Permits and SEPA compliance are required for seismic exploration and drilling (Chapter 78.52 RCW and Chapter 344-12 WAC). Directional drilling from adjoining lands may be permitted (Chapter 78.52 RCW and WAC 344-12-078).

### LANDS WITHHELD FROM LEASING

The Commissioner of Public Lands may withhold any tract or tracts from leasing for oil, gas or other

hydrocarbons if, in his <sup>other</sup> judgment, it would be in the best interest of the state (RCW 79.14.180). Leasing will also be prohibited where prohibited by law.

#### LEASING OF AQUATIC LANDS

The department is currently withholding department-managed marine and estuarine aquatic lands from lease. These include lands under the Pacific Ocean out to three miles, Puget Sound, the Strait of Juan de Fuca, the Strait of Georgia, Grays Harbor, Willapa Bay, and the Columbia River upstream to Puget Island. A future decision to allow leasing or exploratory drilling will only be made after completion of an Environmental Impact Statement and a determination by the Commissioner of Public Lands that the activity would be in the public interest. Surface drilling is prohibited by law in and within 1,000 feet of Puget Sound and the Strait of Juan de Fuca (RCW 90.58.160).

The department will permit oil and gas leasing of department-managed lands under fresh water. Surface drilling is prohibited on these lands. Directional drilling is permitted beyond 200 feet of the ordinary high water mark and as otherwise permitted by law.

#### WATER AND WETLAND AREAS

Oil and gas seismic surveys, drilling, development and production will be prohibited within 200 feet of any Type 1, 2, 3 or 4 waters and wetlands of the state (WAC 222-16-020, -030 and WAC 344-12-040).

#### DEPARTMENT-INITIATED OIL AND GAS LEASE APPLICATIONS

Any person may submit an application to lease state-owned lands for oil and gas purposes (WAC 332-12-240). The depart-

ment may initiate oil and gas lease applications in the name of the state when it appears the state may benefit.

#### NOTIFICATION OF OIL AND GAS LEASING

Notification of impending oil and gas leasing will be provided by department to surface owners of record upon acceptance of oil and gas lease applications in the following situations:

- Severed mineral rights (surface rights have been relinquished by the state) and
- Surface leased by other public agencies.

#### PLAN OF OPERATIONS

A Plan of Operations describing intended activities and measures to mitigate environmental impacts must be submitted to and approved by the department prior to entry and initiation of surface operations. The Plan of Operations must be approved before any permits will be issued.

The operator must conduct exploration activities according to the approved Plan of Operations.

#### RIGHT OF ENTRY

An operator must obtain a Right of Entry permit from the appropriate department Area office to conduct surveys on department-managed land. The operator must also contact the appropriate department Area office prior to entry upon the land.

A Right of Entry permit is not required to conduct surveys on department-managed land under an oil and gas lease, provided the lessee of such land is contracting for or conducting the survey.



## SEISMIC EXPLORATION PERMITS

Shot-hole seismic exploration requires a permit issued by the Oil and Gas Conservation Committee (WAC 344-12-050).

## RESOURCE PROTECTION

Avoid impacts on plant and animal species considered endangered in Washington. Within trust management obligations avoid impacts on species considered threatened, and consider avoiding or lessening impacts on species considered sensitive.

Preserve plant and animal diversity by designating certain parcels of state land under the Registry Program and in Natural Area Preserves.

Administer the Oil and Gas Leasing Program in a manner that identifies and protects cultural resources.

## ROAD CONSTRUCTION

All roads constructed for conducting examinations, drilling, development and production activities on premises leased for oil and gas purposes shall meet or exceed road construction and maintenance standards as specified by the Forest Practices Board (Chapter 222-24 WAC).

## PRELIMINARY INVESTIGATIONS

Preliminary investigations on department-managed lands will be allowed with a Right of Entry permit. Site-specific conditions may dictate certain restrictions. Some preliminary investigations will be prohibited on water and wetland areas.

## SEISMIC EXPLORATION

Normally, all seismic exploration methods will be allowed on department-managed lands. However, site-specific conditions may preclude the use of certain methods entirely or limit or modify their use.

## STRATIGRAPHIC AND EXPLORATORY DRILLING

Oil and gas stratigraphic and exploratory drilling will be allowed on department-managed lands under the following conditions:

- A valid lease is required and
- The lessee must submit a Plan of Operations for approval by the Oil and Gas Conservation Committee and the department's Lands Division prior to commencement of drilling and obtain a drilling permit. (WAC 332-12-360 and 344-12-050.)

## RESOURCE PROTECTION

### SENSITIVE AREA PLANNING

Department-managed lands exhibit a diversity of soils, slope, climate, geologic factors and site conditions. Problem or sensitive areas will be identified to assist development of adequate site-specific permit and lease terms and conditions.

Sensitive areas are locations where disruptions of natural processes or natural coastal resources may cause an unacceptable loss. To specifically identify such areas and develop measures to reduce or eliminate concerns, an organized planning process is necessary.

Sensitive area planning is that portion of the oil and gas leasing process that seeks to:

- Identify sensitive areas,
- Estimate the degree of sensitivity, and
- Develop timely management strategies to minimize conflicts.

Selected sensitive area factors are listed for each SEPA environmental element (Table 3). Additional factors may be added during permit or lease processing. Oil and gas leasing activities may result in a sensitivity in some locations while they may not in many others. Table 3 provides examples of situations which may cause a specific site to be a sensitive area when a certain activity is considered for that location.

Social/political concerns are an important aspect of sensitive area planning

because a considerable number of potential resource conflicts may not be concerns about environmental impacts but rather disagreements about land use or misunderstandings about a project.

Although this discussion emphasizes individual lease area analysis, the department will, in many cases, have already identified a larger general area as possibly sensitive. A designation may be developed because an area has been recognized as a special situation. Designations will be developed as necessary to reduce as much as possible any negative environmental impacts or effects.

A sensitive area is identified by the use of the SEPA environmental checklist and a sensitivity checklist prepared for individual oil and gas leases. If either of these checklists results in a positive sensitive area declaration, a sensitive area analysis will be made for the individual project. This will begin with a written sensitive area environment evaluation review. This assessment may be reviewed by technical specialists. Public hearings may also be used to gather additional information.

Resolution of conflicts may be facilitated by discussions between the parties involved and in some instances proposed operations may be modified to reduce or eliminate the sensitivity.

As specific oil and gas activities are proposed the sensitive area designation process will be initiated on a site-specific basis.

When effective, sensitive area planning will resolve many conflicts and avoid unnecessary environmental impact analyses.

Table 3 Basic Selected Sensitive Area Criteria Factors  
Listed by Environmental Elements

EARTH	ANIMALS
Unstable soils that pose significant erosion potential	Significant wildlife wintering area
Areas prone to movement: slides, slumps, etc.	Significant fisheries impact
"Thin" soil cover	Rare and endangered species
Cumulative effects of leasing activities	Unique island ecology
	Cumulative effects of leasing activities
AIR	LAND USE
Toxic fumes	Significant public demand for use other than multiple use management
High visibility areas	Conflicts with county or city comprehensive plan or zoning
WATER	Conversion to other use
Shorelines of Statewide Significance, and shorelines of the state	Located within city limits
Industrial or domestic watersheds	Presence of a Natural Area Preserve
Ground-water dependency	Distance from concentration of human activity (park, housing, highway, etc.)
Stream Types 1, 2 and 3	Marine biological preserve (RCW 28B.20.320)
Cumulative effects of leasing activities	Size of adjacent ownership tracts
PLANTS	NATURAL RESOURCES
Reclamation problems (harsh site)	Extensive mineral extraction
Unique island ecology	Extensive hydrocarbon extraction
Rare and endangered plants	
Cumulative effects of leasing activities	AESTHETICS
	Significant visual impacts
	Significant duration of visual impacts

Table 3 Continued

LAND MANAGEMENT

Transition of land use in area from natural resource management to more intensive human use

Degree to which the use proposal differs from previous management activities

Character of adjacent development

Value similarity between department and others with an interest in the area

Level of concern by major interest groups

Demand for exclusive use by interested groups

Degree of local community concern

Degree to which a proposal is of regional or statewide concern

Cumulative effects of leasing activities

TRANSPORTATION/CIRCULATION

Routing of exploration and production equipment

RECREATION

Significant previous recreational use of a site

Adjacent or nearby park or recreational area

Operation will result in extensive increase in motorized recreational use

Land-locked parcel within a park

ARCHAEOLOGICAL/HISTORICAL

Impact on a specific cultural resource including native American religious sites

## HERITAGE PROTECTION

The Oil and Gas Leasing Program for state-owned lands must consider protecting their special features. Endangered, threatened and sensitive species of plants and animals, and cultural resources such as archaeological or historic sites are such features.

### Endangered, Threatened and Sensitive Species

Based on designation by the Washington Natural Heritage Program and the Washington Department of Game Nongame Program, rare plant and animal species are assigned to one of three categories:

1. **Endangered:** A vascular plant or wildlife species in danger of becoming extinct or extirpated in Washington within the near future if factors contributing to its decline continue. Populations have typically been reduced to critically low levels, or the habitat has been significantly degraded or depleted. (Extinction means the species is gone throughout its range; extirpated means it is gone from part of its range.)
2. **Threatened:** A vascular plant or wildlife species likely to become endangered in Washington within the near future if factors continue that contribute to its population decline or to habitat degradation or loss.
3. **Sensitive:** (a) A vascular plant species with small populations or localized distribution, that is not now endangered or threatened, but whose populations and habitats may be jeopardized if current conditions continue. (b) A wildlife species of

concern because of its uniqueness, rarity, scientific value or vulnerability to human disturbance or land-management activities.

There are 245 vascular plants listed by the Natural Heritage Program as endangered, threatened, sensitive or possibly extinct or extirpated in Washington. Of these, 11 are considered endangered, 40 threatened and 179 sensitive. A listing of vascular plants of concern can be found in the Natural Heritage Program publication Endangered, Threatened and Sensitive Plants of Washington (DNR, 1984b).

The Department of Game Policy List (Department of Game Policy Manual, WFL-pol-.602) includes 28 species considered endangered or threatened.

The Department of Game Nongame Program and the Department of Natural Resources Natural Heritage Program have developed a Natural Heritage data system. This system contains site-specific information on each known example of the state's natural heritage resources, as well as the most recent scientific literature, lists of information sources for the state and information about land-management agencies.

The system interfaces with the department's data system, TRAX. The department uses TRAX to identify areas with sensitive species.

The Natural Heritage Program will be instrumental in implementing the department's policy to:

Avoid impacts on plant and animal species considered endangered. Within trust obligations, avoid impacts on species considered threatened and consider avoiding or lessening impacts on species considered sensitive.

The objectives of the department's policy are to:

1. Identify those elements most in need of preservation on state lands,
2. Identify sites that contain these elements, and
3. Acquire these sites as Natural Area Preserves or designate them as in need of recognition and special management considerations.

The department and the Department of Game continuously inventory state lands for special plants, animals and plant communities. The inventory process is also aided by interested people outside state agencies. Once a species or site is identified, pertinent information is entered in a data file.

#### NATURAL AREA PRESERVES AND THE REGISTRY PROGRAM

It is department policy to preserve plant and animal species diversity by designating parcels of land under the Registry Program and in Natural Area Preserves.

Sites exhibiting characteristics identified in the State of Washington Natural Heritage Plan (DNR, 1983c) discovered during the sensitive area designation process will be reported to the Natural Heritage Program. Permits and leases for oil and gas exploration and development on these sites will contain conditions and restrictions recommended by the Natural Heritage Program to protect the species or habitat of concern if necessary.

#### CULTURAL RESOURCES

It is the policy of the Department to reduce impacts on sites with important cultural values. A cultural resource is a significant archaeological or historical site. It includes sites, structures and objects significant to Native American cultures, American or Washington history, architecture, archaeology or culture.

These sites and objects are protected by federal and state law, including the National Historic Preservation Act (P.L. 89-665 as amended), the Federal Archaeological and Historic Preservation Act of 1974 (P.L. 93-291) and the State Archaeology and Historic Preservation Act (Chapter 27.34 RCW).

The Office of Archaeology and Historic Preservation (OAHP) maintains a register of archaeological sites. Locating and evaluating sites are ongoing processes. As new sites are discovered, the register is updated and the new information is entered in the department's TRAX system.

Early in the oil and gas leasing process, checks are made for known cultural resources by searching the department's TRAX data file. If a cultural resource is indicated for the section in question, the department corresponds with OAHP to determine suggested or required permit or lease restrictions. Any restrictions are then considered in the Plan of Operation for that permit or lease.

## PRELIMINARY INVESTIGATIONS

During development of this program preliminary investigative activities were examined. The department could, through policies and regulations, restrict, prohibit or modify such actions on a program level.

For department-managed uplands the department will rely on detailed site-specific Plans of Operations, the environmental checklist and the Right of Entry permit process to identify areas which may be impacted by investigative activities. Restrictions and conditions will be developed in cooperation with the operator on a case-by-case basis.

However, the department considers all water and wetland areas to be areas of concern. The department will prohibit seismic exploration and exploratory drilling within a minimum of 200 feet of any Type 1, 2, 3 or 4 waters and wetlands of the state. Other investigative activities proposed for water and wetland areas will be conditioned or denied on a site-specific basis.

### PLAN OF OPERATIONS AND RIGHT OF ENTRY

The Plan of Operations is required as part of the Right of Entry permit application. A description of the area, type and duration of expected activities is included in the Plan. An environmental checklist must be completed and mitigating measures to reduce adverse impacts described when oil and gas activities are proposed. Approval of the Plan of Operations by the department is requisite to granting a Right of Entry permit. Investigative activities must follow the approved Plan of Operations.

Prior to commencement of any operations on lands where surface rights have been relinquished by the state, the lessee

shall: (1) secure consent or a waiver from the surface right owner, or (2) provide full payment for damages, or (3) provide surety, or (4) institute action in Superior Court of the county in which the land is located (RCW 79.14.040). Damage to the surface rights of the owner shall be compensated for in accordance with WAC 332-12-300.

The department shall require proof of notification of intent or proof of agreement with the surface right holder regarding entry and/or damages by the lessee when the lessee indicates intent to conduct surface operations on the lease premises. (WAC 332-12-300.)

As investigation progresses, proposed changes in the original Plan of Operations must be submitted to and approved by the department before their implementation.

A Right of Entry permit is required for any activity on department-managed land unless a lease has already been obtained. The operator must also contact the appropriate department Area office prior to actual entry on the land.

All roads constructed for use in conducting surveys, examinations, exploration drilling, development and production activities shall be in accordance with Road and Construction Maintenance Standards as set forth in Chapter 222.24 WAC.

### INVESTIGATIVE ACTIVITIES

Aerial Photography and photogeologic interpretation may be used to examine geologic, topographic and vegetative patterns that could indicate oil and gas producing formations. This activity occurs early in the process, before the department becomes involved.

Geologic Mapping is normally conducted on foot from existing trails and roads. In remote areas the operation may be supported by pack animals, helicopters or boat. Maps are drawn of geologic features from on-the-ground observations. Areas to be mapped, transportation methods and timing must be described in the Plan of Operations. A Right of Entry permit is required.

Magnetic Surveys are normally conducted from the air. Since no on-the-ground activity occurs, the department imposes no regulations or restrictions.

Gravity Surveys are conducted from aircraft and ground vehicles using existing roads and trails. Surveys done from aircraft are supported by measurements on the ground. Areas to be surveyed, methods, survey stations and timing are described in the Plan of Operations. A Right of Entry permit is required.

Magnetotelluric Exploration and Time-Domain Electromagnetic Soundings normally use existing roads and trails. These surveys cause slight surface disturbances. Location of survey sites, methods and timing of surveys are described in the Plan of Operations. A Right of Entry permit is required.

Geochemical Sampling requires collection of small samples of soil, rock or water using small scoops or soil augers. This may be done along existing roads and trails or on foot. Areas to be surveyed and timing of surveys are described

in the Plan of Operations. A Right of Entry permit is required.

Vibratory (or Thumper) Seismic Surveys normally use existing roads and trails. Area, method and timing of surveys are described in the Plan of Operations. Vibratory surveys are prohibited within 200 feet of Type 1, 2, 3 or 4 waters and wetlands. A Right of Entry permit is required.

Explosive Seismic Surveys normally use existing trails and roads. In remote areas new trail or road construction may be required. Location, methods and timing of surveys must be described in the Plan of Operations. These surveys are prohibited within a minimum of 200 feet of Type 1, 2, 3 or 4 waters and wetlands. The drilling of the shot-hole (normally less than 200 feet deep) requires a permit from the Oil and Gas Conservation Committee and payment of a fee (RCW 78.52.120 and WAC 344-12-050). An environmental checklist is part of the permit application. A Right of Entry permit is required.

Seismic surveys on department-managed lands leased to the Department of Game must be coordinated with the appropriate Department of Game manager prior to issuance of a permit. The department will follow procedures described in the Memorandum of Understanding and Supplement between the Department of Game and the Department of Natural Resources concerning Right of Entry permits.



## OIL AND GAS LEASING PROCEDURE

The department's Oil and Gas Leasing Program is applicant-oriented. The department does not routinely propose tracts for lease unless an application for lease for other tracts within the area has been made. The department may offer tracts that have been overlooked by applicants. If no bonus bid is received for department-initiated applications for lease, the application will be rejected.

Any person may submit an application to lease (WAC 332-12-240). The Commissioner of Public Lands may reject any or all applications for lease when determined to be in the best interest of the state (WAC 332-12-270).

The oil and gas leasing program is strictly controlled by statute. Throughout this discussion RCW and WAC references will be noted and some statutes will be summarized.

A flow chart of the oil and gas leasing and permitting process and their relationship is shown in Table 4.

### PREAUCTION ACTIVITIES

All applications for oil and gas leases are made on a department form and must be accompanied by an application fee (currently \$25).

When an application is received, the department begins its review of the area. A land record check is conducted to determine if the land is available for lease and to determine if there are any encumbrances (e.g., surface rights archaeological/historical sites, endangered plant or animal species, parks, etc.) The site is inspected to identify areas of concern and a SEPA checklist is completed. A Shoreline Management Consistency Determination is completed for those lands which

fall within Shoreline Management Act jurisdiction. Lease terms and conditions are recommended. A sample Oil and Gas Lease Inspection Report is in Appendix B.

Lands Division personnel in Olympia review the Area's lease inspection report and the recommended terms and conditions. SEPA determination is made and the decision is made to lease or withhold part or all of the land covered by the application.

Notification of impending oil and gas leasing will be provided to surface owners of record upon acceptance of oil and gas lease applications in the following situations:

- Severed mineral rights (surface rights have been relinquished by the state) and
- Surface leased by other public agencies.

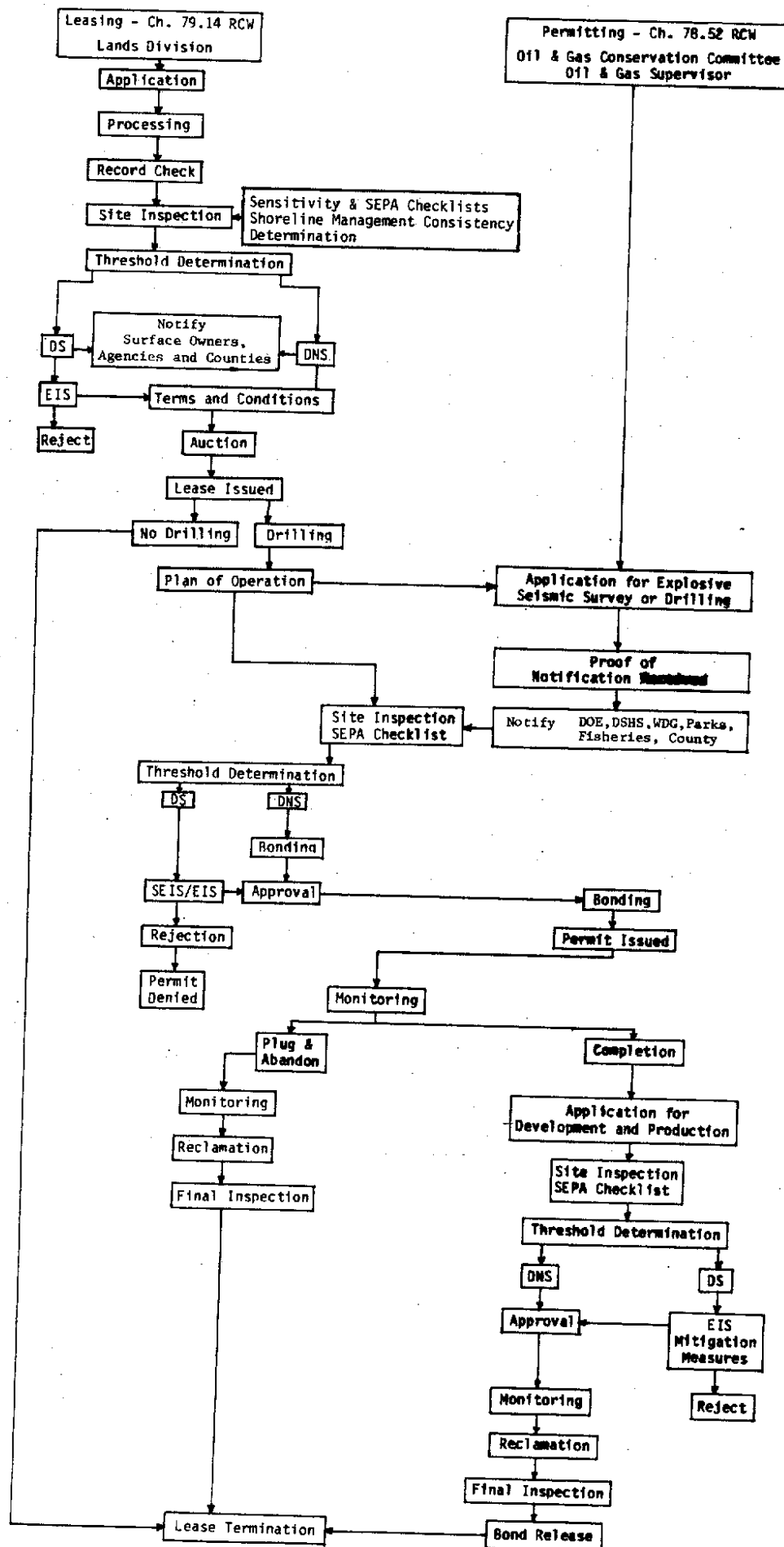
A notice of lease offering is prepared listing each proposed lease. The notice contains lease terms and conditions and encumbrances specific to each lease. The notice is mailed to each applicant, other agencies and all persons indicating an interest.

The notice is also published in a newspaper of general circulation for a minimum of thirty days prior to the auction in Thurston County and in such other manner as the department may authorize. (WAC 332-12-270.)

### AUCTION PROCEDURES

Oil and gas leases are awarded at public auction. Auction schedules are determined by the number of applications but are generally not scheduled at less than six-month intervals.

TABLE 4 FLOW CHART OF LEASE AND PERMIT PROCESSING RELATIONSHIP



Applications received less than 120 days before a scheduled auction are held for the next auction.

The Commissioner of Public Lands may reject any or all bids for an oil and gas lease if determined to be in the best interest of the state. (WAC 332-12-270.)

## LEASES

Leases are issued on forms prepared by the department. The lessee is required to submit a Plan of Operations prior to conducting drilling operations on the premises (WAC 332-12-360). Compliance with the provisions of the Oil and Gas Conservation Act (Chapter 78.52 RCW) is mandatory.

The department reserves the right to lease any subsurface resource not covered by an oil and gas lease. Such leasing is subject to any existing lease rights. (WAC 332-12-290.)

Prior to commencement of any operations on lands where surface rights have been relinquished by the state, the lessee shall: (1) secure consent or a waiver from the surface right owner, or (2) provide full payment for damages, or (3) provide surety, or (4) institute action in Superior Court of the county in which the land is located (RCW 79.14.040). Damage to the surface rights of the owner shall be compensated for in accordance with WAC 332-12-300.

The department shall require proof of notification of intent or proof of agreement with the surface right holder regarding entry and/or damages by the lessee when the lessee indicates intent to conduct surface operations on the lease premises. (WAC 332-12-300.)

Any applicant for a lease contesting an order or decision of the Commissioner

of Public Lands may appeal to the Superior Court of the county in which the lands covered by the application are situated. (RCW 79.01.500.)

## Lease Terms and Conditions

Oil and gas leases are issued for an initial term of five years provided the lessee pays the rental fee and complies with the terms and conditions of the lease. The lease term may be extended to a maximum of 20 years including the initial five years if the conditions of WAC 332-12-390 are met. These conditions are:

1. The lessee has and is complying with all rules and regulations and the terms and conditions of the lease; and
2. The lessee shall be producing oil and/or gas in continuous paying quantities; or
3. The lessee shall be engaged in drilling, deepening, repairing or redrilling any production well without a 90-day cessation of operation; or
4. The lessee shall be actively exploring with due diligence in which one string of tools is in operation on the lease premises or premises included in an approved drilling unit with less than 90 days between the completion of one well and the start of the next; or
5. The lessee is, in the opinion of the department, proceeding and actively pursuing development to efficiently extract oil and/or gas after discovery.

Leases on tracts subject to significant environmental impacts may contain prohibitions against entry, drilling or other

activities. Tracts with such prohibitions may include parks, wildlife refuges, municipal watersheds, residential areas etc.

During the course of a lease, any activities which might result in significant environmental impacts will require completion of the SEPA checklist process by the operator and/or lessee. A Determination of Significance or Nonsignificance will be made in accordance with SEPA. If a Determination of Significance is made, an SEIS or EIS will be prepared by the lessee prior to a decision by the department for the activity.

The lessee is required to obtain the necessary permits from the Oil and Gas Supervisor in accordance with WAC 344-12-050. The Lands Division will furnish a Determination of Significance or Nonsignificance and evaluation to the Oil and Gas Supervisor for consideration along with the Plan of Operation submitted by the operator.

Prior to initiating any activities the lessee shall post a bond to guarantee performance with the terms and conditions of the lease. The department may increase or reduce the amount of the bond as a result of operational changes. (WAC 332-12-350.)

#### Lease Administration

Interagency coordination in the oil and gas drilling permit process will be accomplished as provided for in the Oil and Gas Conservation Act (WAC 344-12-050(5)). The Oil and Gas Supervisor will coordinate monitoring inspections with other agencies with jurisdiction during the time permitted activities occur.

All activities contemplated or undertaken on lease premises must be in accordance with the approved Plan of Operations, the terms of the lease and shall conform to applicable laws, rules and regulations which may regulate the premises and the operations thereon.

As activities permitted under the terms of the lease and the Plan of Operations occur, they will be monitored by the department. Failure to comply with terms of the lease or the Plan of Operations shall result in cancellation of the lease.

#### DRILLING

Stratigraphic Test Drilling normally uses small (less than one acre) drill pads and existing trails and roads. The drillsite is frequently located along an existing trail or road. Holes are drilled less than 2,000 feet to obtain geologic information on the different strata penetrated.

A Plan of Operations which includes location, method, equipment, timing of activity, contingency plans for spills and Department of Ecology-approved plans for disposal of drilling fluids and solid wastes is required.

A permit from the Oil and Gas Conservation Committee and payment of a fee is also required (RCW 78.150.120 and WAC 344-12-050). An environmental checklist is part of the permit application. If a Determination of Significance is made, an EIS or SEIS will be required. A lease is required before stratigraphic drilling begins.

Exploratory Drilling requires an access road and drill pad construction (typically, 2 to 4 acres). Shop and office facilities and fuel and water storage tanks may be erected nearby. Drilling and testing a well may require more than a year to complete.

A Plan of Operations which includes location, method, equipment, timing of activity, contingency plans for spills and Department of Ecology-approved plans for disposal of drilling fluids and solid wastes is required.

A permit from the Oil and Gas Conservation Committee and payment of fees is required (RCW 78.52.120 and WAC 344-12-050). An environmental checklist is part of the permit application. If a Determination of Significance is made, an SEIS or EIS will be required. A lease is required prior to commencement of exploratory drilling.

#### DEVELOPMENT AND PRODUCTION

Development and production activities may have a potential for significant environmental impact. The lessee must apply for appropriate permits

(WAC 344-12-050), submit an environmental checklist and a Plan of Operations (WAC 332-12-280). An updated Oil and Gas Lease Inspection Report will be prepared. If a Determination of Significance is made, an SEIS or EIS will be required. Directional drilling from adjoining tracts may be allowed subject to Chapter 78.52 RCW and WAC 344-12-078.

#### RECLAMATION

Upon termination of all activities the lessee shall remove all equipment, structures and facilities unless otherwise approved by the department and the Oil and Gas Supervisor (WAC 344-12-145). Revegetation of all disturbed areas shall follow the approved Plan of Operations.

Reclamation of the land is a mandatory requirement of each lease (WAC 332-12-480). Termination of the lease and release of the surety is contingent upon acceptance of the reclamation by the department and compliance with the terms and conditions of the lease (WAC 332-12-380).

Upon completion of permitted activities and before lease termination, a final inspection will be made of the property to insure reclamation procedures have been followed according to the terms of the lease.

## GLOSSARY

- Abandon:** To cease producing oil and gas from a well when it becomes unprofitable. Different steps may be involved in abandonment: Part of the casing may be removed and salvaged; one or more cement plugs may be placed in the bore hole to prevent migration of fluids between the different formations penetrated by the bore hole; and the well is abandoned.
- Aquatic Lands:** All state-owned tidelands, shorelands, harbor areas and the beds of navigable water.
- Blowout:** An uncontrolled flow of gas, oil or other well fluids into the atmosphere. A blowout occurs when formation pressure exceeds the pressure applied to it by the column of drilling fluid.
- Blowout Prevention Equipment:** One of several systems of valves installed at the well head to prevent the escape of pressure either in the annular space between the casing and drill pipe or an open hole. Also referred to as BOPE.
- Bonus Bid:** An offer, oral or sealed, by an interested person to acquire a lease. Bids are accepted as a one-time payment and must be in excess of the minimum annual rental.
- Casing:** Steel pipe placed in an oil or gas well as drilling progresses to prevent the wall of the hole from caving in during drilling and to provide a means for extracting oil and gas if the well is productive.
- Casing String:** The entire length of all the joints of casing run into a well.
- Cementing:** The application of a liquid slurry of cement and water to various points inside or outside the casing.
- Christmas Tree:** The control valves, pressure gauges and chokes assembled at the top of a well to control the flow of oil and gas after the well has been drilled and completed.
- Condensate:** The liquid hydrocarbons recovered at the surface that result from condensation due to reduced pressure or temperature of the hydrocarbons existing in a gaseous phase in the reservoir.
- Conductor Pipe:** A short string of large-diameter casing used to keep the top of the well bore open and to provide a means of conveying the up-flowing drilling fluid from the well bore to the mud pit.
- Cuttings:** The fragments of rock dislodged by the bit and brought to the surface by the drilling mud.
- Development:** Work which generally occurs after exploration and furthers bringing in production, including defining the extent of the oil and gas resources and construction of support facilities.

**Development Unit:** The maximum area of a pool which may be drained efficiently and economically by one well.

**Development Well:** 1) A well drilled within a known or proven productive area of an oil or gas field. (2) A well drilled to permit more effective extraction of oil and gas from a reservoir.

**Directional Drilling:** Intentional deviation of a well bore from the vertical. It is sometimes necessary or advantageous to drill at an angle from the vertical. Controlled directional drilling makes it possible to reach subsurface areas remote from the point where the bit enters the earth.

**Drilling Fluid:** A fluid circulated within the wellbore from the surface. Usually a mixture of clay, water and other chemical additives. Air, gas or water can be used as drilling fluid.

**Drill String:** The column or string of drill pipe with attached joints that transmit drilling fluid and rotational power to the drill bit.

**Exploration:** The investigation of oil and gas resources by any geological, geophysical, geochemical or other suitable means.

**Gas Lift:** Any method used to lift liquid to the surface by injecting gas into the well bore from which production is obtained.

**Gravity Survey:** Measurements of the gravitational field at a series of different locations.

**Grouting:** See Cementing.

**Hydrocarbons:** Organic compounds of hydrogen and carbon.

**Igneous:** Those rocks formed by solidification from a molten or partially molten state.

**Lithology:** A description of rocks on the basis of such characteristics as color, mineralogic composition and grain size.

**Log:** A continuous record as a function of depth of observations (electrical, geophysical, geochemical) or well cuttings of the rock, exposed in a well bore.

**Magnetic Survey:** Measurement of a component or element of the geomagnetic field at different locations.

**Magnetotelluric Survey:** An electromagnetic method of surveying in which natural electric and magnetic fields are measured.

**Metamorphic Rock:** Those rocks formed in the solid state by pronounced changes of temperature, pressure and chemical environments.

**Permeability:** A measure of the ability of fluids or gas to diffuse or pass through a porous (rock) material.

**Plugging:** To place cement or mechanical plugs into a well at specified intervals to prevent contamination of freshwater or oil and gas zones; or to prevent the interzone migration of fluids.

**Pool:** An underground reservoir containing a common accumulation of oil or gas, or both. Each zone of a structure which is completely separated from any other zone in the same structure such that the accumulations of oil or gas are not common with each other is considered a separate pool and is covered by the term "pool".

**Porosity:** The ratio of the volume of spaces in a material to the volume of its mass.

**Production:** Extracting oil and/or gas in paying quantities.

**Reclamation:** The reasonable protection and rehabilitation of all land subject to disruption from exploration, development and production of an oil and gas resource.

**Reserve Pit:** A waste pit, usually an excavated earthen-walled pit. It may be lined with plastic or other impervious materials to prevent contamination of the soil.

**Reservoir:** A section of porous and permeable sedimentary rock containing commercial quantities of oil or gas.

**Sedimentary:** Those rocks formed of fragments of other rock deposited by wind or water.

**Separator:** Apparatus used for separating oil, gas, water, etc., as it is produced.

**Shot Hole:** In seismic prospecting a bore hole in which an explosive is placed for generating seismic waves.

**Shows:** A trace of oil or gas detected in a core, cuttings or circulated drilling fluid; or interpreted from electrical or geophysical logs run in a well.

**Stratigraphic Test or Well:** A hole drilled to obtain information on the thickness, lithology, sequence, porosity, permeability and age of the rock penetrated. Frequently drilled to evaluate a potentially productive oil or gas zone.

**Surface Pipe:** The first string of casing (after the conductor pipe) that is set in a well, varying in length from a few hundred to several thousand feet. Some states require a minimum length to protect fresh water sources.

**Tank Battery:** A group or collection of tanks located at convenient points for storing oil prior to transporting by truck or pipeline.



**Treater:** Mechanical equipment used to separate oil from water.

**Wetlands:** Those areas extending landward for 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark; all marshes, bays, swamps, floodways, river deltas and flood plains associated with or influenced by any stream, river, lake or tidal water; or any combination thereof.

**Wildcat Well:** An exploratory well drilled for oil or gas on a geologic feature not yet proven to be productive, in an unproven territory or to a zone that has never produced or has not been known to be productive in the general area.

## REFERENCES

## REFERENCES

- Bates, Robert L. and Julia A. Jackson, editors 1980. Glossary of Geology. American Geological Institute. Falls Church, VA.
- Compton, Robert R. 1962. Manual of Field Geology. New York: John Wiley and Sons.
- Dobrin, Milton Burnett 1976. Introduction to Geophysical Prospecting. New York: McGraw-Hill.
- Gatlin, Carl 1980. Drilling and Well Operations. In Petroleum Engineering. NY: Prentice-Hall Inc.
- Golz, Alfred R. 1965. Land subsidence -- why the state is concerned. In Landslides and Subsidence Proc. pp. 97-105. Calif. Res. Agency. Sacramento, CA.
- Hunting, Marshall T., W.A.G. Bennett, Vaughn E. Livingston Jr. and Wayne S. Moen 1961. Geologic Map of Washington. Wash. Dept. of Natural Res. Div. of Geol. and Earth Res. Olympia, WA.
- McFarland, Carl R. 1983. Oil and Gas Exploration in Washington, 1900 - 1982. Wash. Dept. of Natural Res. inf. circ. no. 75. Olympia, WA.
- McPherson, R.B., D.A. Waite, D.B. Shieler and M.A. Glora 1980a. Estimated Environmental Effects of Deep Drilling. National Technical Information Service ONWI-13.
- McPherson, R.B., D.A. Waite, D.B. Shieler and M.A. Glora 1980b. Estimated Environmental Effects of Geologic and Geophysical Exploratory Activities. National Technical Information Service ONWI-105.
- National Petroleum Council 1971. Environmental Conservation. Washington DC.
- Propokovich, Nicola P. 1972. Land subsidence and population growth. In 24th Intern. Geol. Conf. Proc. 13:44-54.
- Rau, Weldon W., H.C. Wagner 1974. Oil and Gas in Washington. In: Energy Resources of Washington. Wash. Dept. of Natural Res. Div. of Geol. and Earth Res. inf. circ. no. 50. Olympia, WA.
- Ruth, C.W. 1973. Magnetotelluric Field Procedures Manual. Shell Oil Co. Houston, TX.
- U.S. Department of Agriculture 1981. Oil and Gas Lease Applications of the Los Padres National Forest. USDA Forest Serv. PSW Region. Washington D.C.: USGPO.

- U.S. Department of Interior 1983. Proposed Oil and Gas Exploration Within the Coastal Plain of the Arctic National Wildlife Refuge, Alaska. Washington, DC.: USGPO.
- U.S. Department of Interior 1982. Endangered and Threatened Wildlife and Plants. Fish and Wildlife Serv. Washington DC.: USGPO.
- U.S. Department of Interior 1981a. Environmental Assessment of Oil and Gas Leasing in the Roswell District. Bur. of Land Mgmt. Roswell, NM.
- U.S. Department of Interior 1981b. Oil and Gas Environmental Assessment of BLM Leasing Program, Dickinson District. Bur. of Land Mgmt. Dickinson, ND.
- U.S. Department of Interior 1981c. Oil and Gas Environmental Assessment of BLM Leasing Program, Lewistown District. Bur. of Land Mgmt. Lewiston, MT.
- U.S. Department of Interior 1980a. Buffalo Resource Area Oil and Gas Environmental Assessment. Bur. of Land Mgmt. Casper, WY.
- U.S. Department of Interior 1980b. Oil and Gas Environmental Assessment of BLM Leasing Program. Bur. of Land Mgmt. Miles City, MT.
- U.S. Department of Interior 1963. Plain Facts About Oil. Washington DC.: USGPO.
- U.S. Environmental Protection Agency 1977. Impact of Abandoned Wells on Ground Water. Ada, OK.
- University of Texas at Austin, Petroleum Extension Service 1979. A Primer of Oilwell Drilling. Austin, TX.
- ver Wiebe, W.A. ----. How Oil is Found. Univ. of Wichita. Wichita, KA.
- Washington State Department of Ecology 1983. Washington State's Visibility Protection Program; Revision to Washington State Implementation. Olympia, WA.
- Washington State Forest Practices Board 1982. Washington Forest Practices Rules and Regulations. Olympia, WA.
- Washington State Department of Game 1983. Washington State Special Animal Species. Olympia, WA.
- Washington State Department of Game 1982. Proposed Oil and Gas Leasing on Department of Game Lands in Washington State Block 1 South Segment of the L.T. Murray Habitat Management Area. Draft Supplemental Environmental Impact Statement. Olympia, WA.
- Washington State Department of Game 1980. Proposed Oil and Gas Leasing on Department of Game Lands in Washington State. Final Environmental Impact Statement. Olympia, WA.

- Washington State Department of Natural Resources 1984a. Draft Aquatic Land Policy Plan. Marine Land Mgmt. Div. Olympia, WA.
- Washington State Department of Natural Resources 1984b. Endangered, Threatened & Sensitive Vascular Plants of Washington. Wash. Natural Heritage Program. Olympia, WA.
- Washington State Department of Natural Resources 1983a. Forest Land Management Program. Olympia, WA.
- Washington State Department of Natural Resources 1983b. Forest Land Management Program Final Environmental Impact Statement. Olympia, WA.
- Washington State Department of Natural Resources 1983c. Natural Heritage Plan. Wash. Natural Heritage Program. Olympia, WA.
- Washington State Department of Natural Resources 1978. Geology of Washington. Div. of Geol. and Earth Res. reprint 12. Olympia, WA.

## APPENDICES

# APPENDIX A

## DRILLING MUD MATERIALS

Drilling materials identified as toxic or hazardous are to be handled, stored and transported in accordance with Chapter 173-303 WAC.

FUNCTION	MATERIALS	WHY USED
Lubricants	Certain oils, graphite powder and soaps	To reduce downhole friction
Flocculants	Salt, hydrated lime, gypsum and sodium tetraphosphates	To increase gel strength. Causes some solids to settle out
Filtrate Reducers	Bentonite clays, sodium carboxy-methyl cellulose (CMC) and pregelatinized starch	Reduce filter loss. Prevent "water loss" to porous formations
Foaming Agents	Anionic foaming chemicals	Causes formation water to foam helping gas or air drilling to continue
Restore Circulation	Asphalt emulsions, asbestos fibers, shredded plastics mica flakes, nut hulls, cedar fibers, cottonseed hulls and many other materials	To stop mud loss to porous zones
Shale Control Inhibitors	Gypsum, sodium silicate, chrome lignosulfates, lime and salt	To stop or prevent swelling of shales or clays
Surface Active Agents	Surfactant chemicals	To permit better mixing. Example: water and oil
Thinners and Dispersants	Quebracho, some polyphosphates and lignitic materials	To prevent too high a viscosity, improve pumpability, provide better solids distribution in muds

FUNCTION	MATERIALS	WHY USED
Viscosifiers	Bentonite, CMC, attapulgite clays and asbestos fibers	To increase viscosity for cuttings removal and gel strength
Preservatives	Formaldehyde	Prevent starch mud from fermenting
Cement Decontamination	Sodium bicarbonate	Prevents mud destruction
Calcium Removers	Caustic soda, soda ash, certain polyphosphates (SAPP) and sodium bicarbonate	To prevent mud destruction by gypsum or anhydrite
Weight Materials	Barite, lead compounds, iron oxides and high specific gravity compounds	To increase mud weight (pounds per gallon) to hold formation fluids in place and prevent hole caving
Corrosion Inhibitors	Hydrated lime, amine salts and dichromate salts	To prevent corrosion of drilling equipment and casing
Oil Emulsion	Special emulsifiers or soaps	To make oil-in-water or water-in-oil emulsions for "oil base" mud

#### Sources:

American Association of Oilwell Drilling Contractors. Toolpusher's Manual. Section 0. September 1970.

Gatlin, Carl. "Drilling and Well Completions." In Petroleum Engineering. Chapter 6. Prentice-Hall, Inc. New York. 1960.



# APPENDIX B

## STATE OF WASHINGTON DEPARTMENT OF NATURAL RESOURCES BRIAN J. BOYLE, Commissioner of Public Lands OIL AND GAS LEASE INSPECTION REPORT

Date 4-13-84

Applicant's Name SENTURE DE BOIS PERMAN Application No. 85585

The following items pertain to the area to be leased:

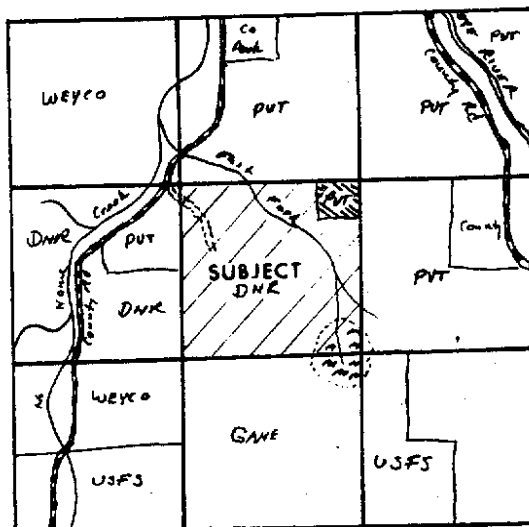
- Surface Ownership: State ☒ Deeded ☐ Both ☒  
NE 1/4 NE 1/4 SURFACE RIGHTS DEEDED TO SENTURE DE BOIS PERMAN  
(Name of surface owner if other than state)
- Current Use Forestry
- Ground Cover Second growth timber
- Topography Gentle to moderate
- Access: State ☒ Private ☐ Other ☐  
COUNTY and DNR ROADS  
(Explain) COUNTY REQUIRES ROAD PERMIT FOR HEAVY EQUIPMENT
- Zoning FORESTRY AND AGRICULTURE  
(Obtain from current County Comprehensive Plan)
- Archeological/Historical site? ☐ Endangered plant or animals? Yes ☒ No ☐
- Other Information TYPE 2, 3, 4, 5 in area  
TYPE 4, 5 water on DNR land  
93-001787 PLANT COMMUNITY  
002386 SPECIAL ANNUAL

Sec 16 Township 18 3 E, W.M. THURSTON County

Scale: " = 4,000 feet

On the plat, indicate the location of the following on the property and within one mile radius of property:

- Surface ownership, if ownership other than state.
- Adjacent surface ownership.
- Incorporated areas.
- Municipal boundaries.
- Natural Area Preserves, endangered species, plant and animals.
- Rivers, lakes, wetlands and other natural features.
- Residences and other buildings.
- Ground cover.
- Game Department lands.
- State parks and other parks.
- Any other significant features.



DNR - FEE SIMPLE  
 DNR - Owns Mineral Rights Only  
 WETLANDS - MASHN

RES 30-1820 (12-82)